Engineering Record

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Financial Situation

RETURN to normal business conditions, or at least to the condition existing prior to the war, is indicated by the present financial situation. Bond trading was resumed Nov. 28 on the New York Stock Exchange, while on the date of this issue trading in stocks will likewise be allowed. Very properly the trading is restricted both as to issues and prices, but greater latitude in both will come as conditions continue to improve. The steel companies are unusually optimistic as to the outlook, while in general those who have made a close study of the situation have every confidence that the low point is well past. With the export situation improved, the money market easier and confidence restored, there is reason to take a most hopeful view of the immediate future.

A Road Number

SINCE this issue of the Engineering Record appears the week before the convention of the American Road Builders' Association, it is devoted largely to highway articles. They are, without exception, brief, yet they contain unusually valuable data. Such articles, for example, as Mr. Grossman's on thin asphalt block pavements, Mr. Kelley's on the standards of the Iowa Highway Commission for steel bridges—being a companion article to Mr. McCullough's on concrete bridge standards, published in the Engineering Record of Nov. 7—Mr. Kinney's on the maintenance of concrete roads, and Mr. Richardson's on stone-filled sheet-asphalt surface mixtures contain just the sort of data that road builders are seeking. Space forbids mention of the other highway articles—six in number—but they are commended to the careful reading of road engineers and contractors.

A Desirable Departure, But—

LAST week the American Society of Mechanical Engineers assigned two of the sessions of its annual meeting to discussions of public service problems. It was a commendable departure, and, if the favorable comments of those in attendance count for anything, further sessions of this character would be welcomed. Municipal engineering, however, is very largely civil engineering—in the narrow, but customary, acceptance of that term. Mechanical engineering is of less wide application in municipal work. From the point of view of efficient citizenship, and on account of the ability of all engineers to grasp broadly engineering problems outside their immediate specialties, it is important that the members of the American Society of Mechanical Engineers be informed on municipal problems that the engineer is specially fitted to solve. The Engineering Record heartily endorses the spirit in which the sessions were held, but it believes that they should have been held jointly with the American Society of Civil Engineers.

Keeping Good Men in Office

AT this season, with election day passed and changes in municipal and State administrations coming with the new year, it is time to call attention to a practice which obstructs progress in public works development. This is the discharge—sometimes termed "resignation"—of competent city and State engineers for political reasons. A man may have been at work several years, for example, on the development of a new water supply for his city. Through long experience he is familiar with all of the details of the problem and is the logical person to continue in charge of the work until it is finished. Yet what happens? He may have served under a Democratic administration. The incoming Republican officeholders immediately begin the work of municipal house-cleaning and out goes the city engineer. He is replaced by a man entirely unfamiliar with the work and the city bears the expense while the new executive is being educated in his new duties. While it is sometimes desirable to infuse new blood into an organization which shows signs of decrepitude, it should be remembered that no patient, even of rugged constitution, can undergo a continuous series of such operations without being disabled. If a State or municipal engineer is competent keep him in office, irrespective of his political faith.

Two Road Congresses Or One

NEXT week the American Road Builders' Association holds its annual convention and, similar to last year, faithful road enthusiasts and the manufacturers will take a second long trip to attend an important road meeting. This journal has already voiced a strong protest against a continuance of this wasteful arrangement. There is need for only one comprehensive road congress each year; sectional conventions, like the Northwestern, at Milwaukee, the Massachusetts, at Boston, and many others will supply the means for treating local problems. The burden of holding two large meetings falls heaviest on the manufacturers. They have not borne the load without grumbling, but few have had the courage to stay out of one show and thus suffer by comparison with their competitors. From the technical point of view there is no excuse for two congresses. The papers generally cover the same ground and, though valuable, in neither do they, as a rule, rise above a discussion of fundamentals, already well known to the engineers and experienced builders present. As far as advancing the art is concerned, therefore, one large meeting is sufficient; the educational work can be done as effectively by local gatherings, taking in one State, or a group of States having the same highway problems. Fortunately the situation seems to be clearing, and the American Highway Association is prepared to meet the Road Builders' Association to consider the proposal of holding a joint congress in San Francisco in 1915, the meeting being handled, so the plan runs, under the auspices of a committee of five, two from each association and a fifth selected by the other four. It is earnestly hoped that the plan will be adopted and that its consummation at San Francisco may be so satisfactory to all concerned that separate congresses will never thereafter be considered.

Publicity vs. Public Apathy

"IT must succeed on its merits"—that is the position the engineer rightfully takes with reference to projects he recommends. He often forgets, however, that, on the one hand, life is so complex that the project which waits for voluntary attention seldom gets it and that, on the other, there are always opponents anxious to represent the superior advantages of other projects or cast discredit upon the one proposed. The subject is particularly pertinent to municipal engineering projects. Something must be done to force a too-busy public to give consideration to municipal engineering projects, to meet the arguments for other schemes and point out the errors, intentional or not, of the opponents. This need is being more and more appreciated by municipal engineers, as is evidenced by publicity campaigns for all manner of municipal enterprises. In this issue, beginning on page 644, are three articles on publicity in engineering work, presenting three phases of the subject. Mr. Cooke discusses the general problem as applied to a municipality, Mr. Drayer shows what engineering societies can do, while Mr. Ankeney recites actual experience in handling the publicity for a great engineering work. The Engineering Record believes that the reading of these articles will carry conviction. It should be emphasized, however, that the object in view in such publicity work is not to glorify the engineer but to educate the public to an appreciation of the necessity and importance of engineering works. Perverted from this purpose, it must quickly fail, for newspapers and the public will at once discredit the project if a desire for personal aggrandizement is suspected. To those who are not yet convinced of the desirability of publicity for engineering work the Engineering Record suggests a reading of the articles referred to and, further, that in reaching a decision as to the desirability of publicity in a given situation the engineer must frequently choose between publicity and public apathy.

Licensing of Architects

IN view of the interest displayed in the licensing of engineers, it is worth noting the status of licensing in a profession somewhat allied to our own. While conclusive action was not taken on the report of the committee on legislation of the American Institute of Architects, at the convention of that body in Washington last week, the views of the committee are, nevertheless, of interest.

First, the committee unequivocally recommends that architects be licensed, and, second, states that the States having license laws have proved that the public benefits thereby. The committee, however, believes that the laws now in force in some of the States need revision if they are not to become a check to architecture. The chief feature criticised in existing laws relates to the definition of "architect," which emphasizes attainments in the "science of building" rather than in the "art of building," as the committee expresses it.

On the significant point of the influence of licensing upon the standards of architecture, the committee says frankly that it sees no improvement over the standards in States where licenses are not required. This is due, in its opinion, to the fact that the examinations for licenses are based chiefly on the structural features involved in architectural work and not upon planning, grouping, design and color. It is natural, therefore, to expect an improvement in the structural features of buildings rather than in the artistic. The committee advocates a change in the character of examination, so that the purely architectural side will be given greater prominence.

Despite the committee's emphatic stand, the institute did not adopt or approve the report. The sentiment seemed to be that the matter was one for State consideration and that the institute, being a National body, should not attempt to make a decision which should be based upon local considerations. Nevertheless, the trend of thought in that profession is indicated by the fact that there are now six States in which architects are licensed, and at least nine others which are working toward that end.

Valuation Field Details

ON page 638 is an abstract of the second tentative draft of instructions issued by the Interstate Commerce Commission to the roadway and field parties on the railroad valuation work. The instructions bring home the fact that the problems of the Government's tremendous undertaking are not confined to the broad questions of original cost, depreciation, present value and the like. Whatever theory of valuation is ultimately accepted, the men in the field will have no small task finding and measuring the myriad of elements that comprise the physical plant.

The parties assigned to roadway work are directly responsible for the quantities covered by a dozen or more of the commission's classification accounts, and in addition must identify and locate the special structures which other parties will inventory in detail. Those who have walked track and tried to check up for taxation or other purposes the physical features of a road know how easy it is to pass from stone to gravel ballast without noticing it, and then awake to the fact that the right-of-way fences have disappeared around a curve. Whether the roadway party, which has a number of eyes, and which must necessarily move slowly and measure as well as note changes, can be counted on to catch every item is open to question. There is a great variety of elements, from extra spiking on curves to half-buried pipe culverts, to be on the lookout for, and they cannot be counted on to follow any rule as to order or frequency of appearance. The carriers are urged to send pilots familiar with their property, but it is doubtful whether the roads themselves possess men familiar with the property in all that the specifications require. Even if the pilots know their ground, details are measured and noted by men foreign to the standards of the road, who must make sketches of whatever is not standardized and record snap judgment as to the condition of the items, after which other men equally new to the property must interpret the notes. Taken all in all, if the Division of Valuation escapes large blocks of jumbled and incomplete notes, impossible locations and other dimensions and untrustworthy estimates of condition, it may be counted lucky.

Personal Liability for Fire

UNDER the same caption as used for this article the Engineering Record discussed in its issue of Sept. 12, this year, the suit brought by the fire commissioner of New York City against property owners for the recovery of the cost of extinguishing a fire in one of their buildings. Decision on the case, on appeal, has now been rendered, and while further appeal is possible, the case is so interesting and so important that a statement of its present status is warranted. Eventually, of course, the decision may be reversed. As it now stands it agrees with the point of view taken by this journal.

It will be remembered that the property owners in question had been ordered by the Fire Prevention Bureau to install an automatic sprinkler system. The order was not complied with. On Jan. 31, this year, a fire broke out in the premises and did considerable damage. The fire commissioner, accordingly, entered suit to collect the cost of extinguishing the fire, estimated at $1500.

The Appellate Division of the Supreme Court in a unanimous opinion has now decided that the city has a right to enforce payment. Going further, the decision provides a legal basis for firemen to collect damages for injuries received when engaged in fighting such fires. The defense, on a demurrer, had contended that a criminal intent in a fire was necessary to enable the department to collect and that failure to install sprinklers "did not start the fire." The lower court decided in favor of the defendant and the commissioner appealed.

The Appellate Division in its decision is very definite. One sentence reads as follows: "Upon the facts stated in the complaint, admitted and not explained, we find no difficulty in holding that the defendant's failure to obey the orders of the fire commissioner was both culpable and negligent."

The decision is based upon a violation of definite sections in the New York City charter. It is to be expected that if it finally stands, either without appeal or by confirmation of the highest court of the State, it will set the example to other States and that similar legislation will result. Without a doubt fire-prevention associations would gladly take up the propaganda.

What Is City Planning?

POPULAR interpretation of problems and terms more or less technical is likely to be seriously in error, and such is the case, so a committee of the American Institute of Architects finds, with the conception of the term "city planning." To the common citizen it means the opening of a new street, the location of a public building, the planting of park strips or the building of an ornamental bridge. Seldom, however, has the decision on any one of these problems been reached after careful examination into the future, with a view to co-ordinating the improvement with a general plan of development which has been adopted after a scientific study of the city's probable future needs.

The usual procedure, the committee finds, is for somebody, because of business environment, or real estate holdings, or, in some communities, because of imperative traffic necessities, to initiate an improvement to serve some peculiarly individual needs. Various interests are at once arrayed against each other and the final outcome is a compromise, very frequently not in conformity to a desirable general plan of development. It need not be said that proper city planning does not proceed along such lines. As the committee succinctly puts it, "City planning is not a hurried and obstructed effort to meet past or present needs, but has to do with a logical analysis of present conditions with a view to a consistent and comprehensive betterment through the years to come, free from the influence of ulterior, individual motives."

It is but natural that the present conditions should prevail. We cannot over night change the methods of municipal procedure, and for some time, therefore, we must bear with present conditions, attempting nevertheless to spread, as occasion permits, ideas as to what correct city planning really is. Some communities have, indeed, made a good start, and, while it is not isolated, the work in New York deserves the commendation, at least, of having proceeded along scientific lines. There the studies have been made with a view to determining the necessary and desirable accommodations for the population, and that is the fundamental factor in any logical plan of improvement.

The most obvious procedure in any scheme for improving the comfort and well-being of citizens or the appearance of the municipality is to take the immediate problems in hand and solve them along a higher plane than before attempted. It should be borne in mind, however, that this is a first step only, and that, for real "city planning," the solution should be divorced from individual interests and should be made to fit into a broad comprehensive plan, which itself is founded on a careful study of local conditions and is in accord with certain general basic principles now well laid down in the literature of city planning.

Conference of City Managers

ANOTHER national society of importance to engineers came into being last week. Though the number of representatives gathered at Springfield, Ohio, to form the City Managers' Association was small, it is significant that a man from Amarillo, Texas, promised ten new members from his State alone in another twelve months. At present there are at least sixteen cities operating under this form of government, the adoption of which at Dayton has given the movement so much publicity and so strong an endorsement.

Extension of the list of national societies is, in general, undesirable, for there is much overlapping of aims and duplication of effort on the part of existing organizations. However, few will deny that these pioneers, most of them engineers, need to exchange experiences and to gain the strength which comes from associating with men engaged in the same work. Now, if ever, the time when there should be a strong feeling of fellowship between them, for both they and the idea are on trial.

That the movement has come to stay seems evident from the proceedings. Every man in reciting what had been done in his city indicated that he was getting substantially the same result as his fellow managers were, and that result was higher efficiency. The means by which inefficiency was reduced, as recounted by these men, varied as the problems varied, so that it is no more possible to lay down standard methods than it is for a capable foreman to recommend a successful formula for "hiring and firing" men.

One of the greatest problems of the city-manager form of government, unforeseen probably at its start, but referred to again and again in the convention, is that of sustaining the interest of the public in its own welfare. At Dayton, the flood disaster brought to the people a democratic spirit, but to keep this alive Mr. Waite has fostered various adjuncts in the way of citizens' organizations. The Greater Dayton Association, with 7000 members, the Civic Music League, a Municipal Baseball League, a Playgrounds and Garden Association and other organizations with definite aims have been formed.

Publicity for municipal affairs is also needed for success, and while the newspapers may be relied upon to point out defects, fancied or real, constructive help is essential. A municipal newspaper may be necessary to educate the people to a realization of the advantages which they are receiving from the new form of government. Mr. Waite and one of the Springfield commissioners both admonished the 150 business men, gathered at a banquet to do honor to the visiting managers, that the new plan needed their continued interest, else the movement would fail.

The results so far obtained from the city-manager form of government are, indeed, gratifying, and with the help that the new association can give its members even better progress may be expected in the near future. Experience will help to crystallize procedure, and these experiences and the resulting methods will be exchanged at the clearing house which the meetings of the new association will form.

Fire Prevention Progress at Boston

RESULTS of much engineering importance are likely to develop from the organization at Boston, Mass., on Aug. 1, under Chap. 795 of the Acts of 1914, of a special department of fire prevention for the metropolitan district, which includes twenty-two municipalities centering about the State capitol, and within a maximum radius of about 12 miles. Although the problems confronting the new department are similar to those dealt with by the bureau of combustibles in New York City, the fire prevention bureau of Newark, N. J., and the fire marshal of Indiana, the work is of particular interest on account of the close geographical relations of the cities and towns in the district and the intensely individual local development which flourishes in the suburban communities now brought under centralized control in respect to the reduction of fire hazards.

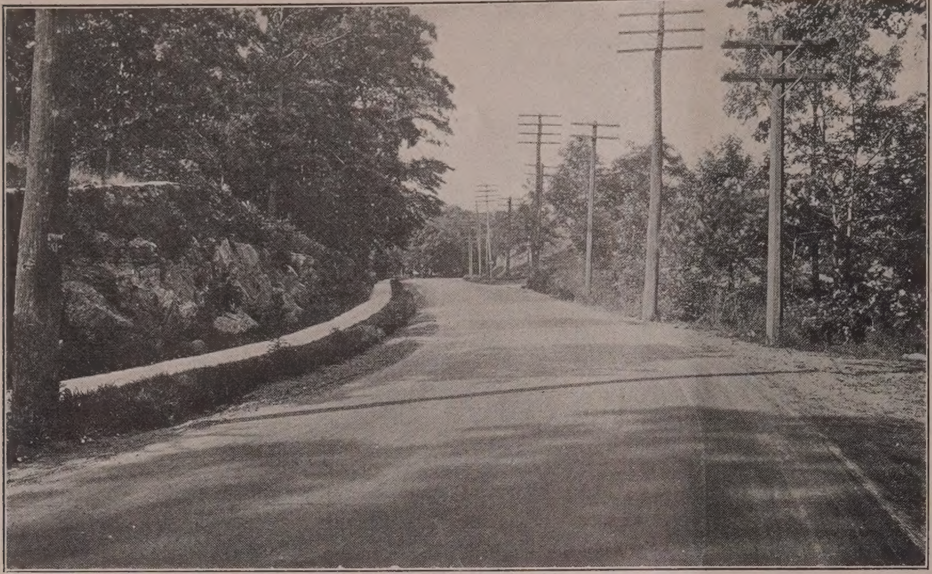
By the establishment of a fire prevention commissioner having wide powers throughout the entire district and in such cities and towns of the State as may hereafter vote to accept its provisions, the act eliminates the possibilities of conflict among local authorities and affords a basis for thoroughly constructive work backed by the full power of the State. All existing powers, other than those held by the legislature and the courts, in relation to the keeping, storage, use, manufacturing, sale, handling, transportation, or other disposition of inflammables and explosives and the use of engines not employing steam as a motive power are vested in the commissioner, who has entire authority over permits, the abatement of menaces, the power to order the installation of automatic sprinklers in a great variety of establishments, besides the right to require the installation of dry pipes with outside connections in the basements of any buildings within the district.

The commissioner may promulgate rules bearing upon the keeping of extinguishers, the accumulation of rubbish, removal of combustible refuse, the setting of fires out of doors, obstruction of fire escapes, control of smoking in shops and mercantile establishments and many other matters of direct concern to the cause of fire prevention; he has authority to require the head of every fire department in the district to investigate and report upon all matters relating to the fire hazard; the right to enter at reasonable hours any building or vessel to make inspection where suspected conditions exist, and is established as a clearing house of information upon all fires occurring within the district.

Local fire department chiefs are required to report to the commissioner the cause and other points, so far as known, in connection with every fire in their jurisdiction, and the co-operation of insurance companies with respect to the furnishing of full information is also rendered available by the act. The establishment of factories producing inflammable goods or involving processes of fire risk to adjoining or adjacent property comes under the authority of the commissioner and, in a word, his office is the court of last resort upon the general subject of fire prevention in this area.

The engineering value of the work will be cumulative and the administration of the office provides for full stenographic reports and publicly open records of hearings upon the many important topics which will come before the commissioner in due course. An investigation of fireproof shingles is now under way, together with the question of requiring garages to install separating devices to prevent the discharge of gasoline into sewers, bearing directly upon the problem of preventing explosions in sewers such as occurred at the East Boston station of the Metropolitan Water and Sewerage Board last June. Extended hearings have been given to representatives of electric vehicle and accessory manufacturers in connection with the standardization of electric battery charging facilities in garages, and many other problems are receiving attention. So far as has been possible in the time elapsing since the organization of the work, the occurrence of a fire in a particular industry has led to an investigation of the possibilities of preventing similar fires in other establishments of the kind, a notable study having been made of boiler shop fire hazards as affected by riveting processes.

Persistent offences in the line of obstructing hydrants have been stopped and an educational campaign among school children and industrial workers has been inaugurated. The appeal to the former is being made by two former teachers experienced in presenting lessons to youth. The message to the latter is carried by two inspectors in good standing with the labor unions. As a source of helpful material the new department is likely to be highly regarded by engineers concerned in fire protection and the results of its operations will be watched with interest.



TWO-INCH ASPHALT BLOCK ON MACADAM FOUNDATION IN PELHAM MANOR

Thin Asphalt Block Pavement for New York State Highways

Heavily Traveled Automobile Routes, Paved with Blocks Only 2 Inches Thick, Give Satisfaction—Special Joint to Prevent Creeping on Curves and Grades

By LOWELL GROSSMAN
Resident Engineer, New York State Highway Commission

With the advent of an asphalt block only 2 in. deep, replacing the former types 3 and 4 in. deep, it became possible, from a consideration of first cost, to use this material for paving New York State highways. The Albany Post Road, for a distance of several miles north of Tarrytown, was paved in 1911 under the jurisdiction of the Town of Mt. Pleasant, N. Y., with 2-in. block laid on a 4-in. concrete foundation. This road is a very popular tourist route and bears the bulk of the through automobile traffic from New York City along the Hudson River. Under such traffic conditions the asphalt block in Mt. Pleasant has given satisfactory service, and at present, after 3 years of heavy use, the surface is as smooth and even as when it was originally constructed.

Macadam or Concrete Foundation

The first section of asphalt block laid by the New York State Highway Commission was on the Shore Road in the village of Pelham Manor during the latter part of 1912. Traffic on this road is undoubtedly the severest that is carried on any highway with a paved width of only 20 ft. in this section of the United States. Censuses taken frequently show a traffic of 1500 to 1600 vehicles per hour, and it is conservatively estimated that throughout the touring season the average traffic is not less than 5000 vehicles per day. The asphalt block pavement on this section of road was laid on an old macadam foundation which had been scarified, reshaped, and thoroughly compacted by rolling and watering. At present, after the terrific traffic of two years, the surface of the pavement is practically in as good condition as when it was completed in 1912.

In view of the excellent service rendered by the asphalt block pavement of recent years it was decided by the authorities controlling the selection of pavements in Westchester County to use this type under conditions of high frequency and high-speed automobile traffic, and where the character of the adjacent property was such as to require a comparatively noiseless, dustless, attractive looking pavement. This decision has been followed, except for locations on steep grades where brick pavement with beveled edges is used to provide better footing for horses.

Several pavements have been constructed during the past year under the conditions of traffic and location already outlined. Among them the Ossining Village State highway is typical. The length of this improvement was 2.17 miles, and the area paved, in widths varying from 20 to 45 ft., was 21,000 sq. yd. of asphalt block and 17,000 sq. yd. of hillside brick. The contract prices bid were $1.50 for asphalt block and $1.64 for hillside brick, exclusive of a concrete foundation 5 in. thick which cost $0.64—all the prices being per square yard.

In the laying of asphalt block pavement, there are several noteworthy points. Upon the prepared foundation of either concrete or old macadam there is laid a cushion bed of lean mortar in the proportion of 1 part Portland cement to 4 parts of sand mixed with just sufficient water to permit the cement to set. The mortar bed is carefully evened out by drawing across the road a light 3-in. I-beam which rests at each end upon a thin iron plate laid to conform to the desired surface lines. The plate is used merely as a template and is removed before laying block. One of the most pleasing characteristics of the asphalt block pavement, its freedom from cross waves and consequently its easy riding qualities, depends upon the smoothness of its bed. Special care, therefore, is given to this part of the construction.

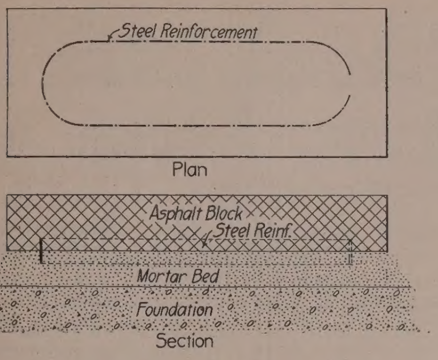
Laying Blocks

Upon the prepared bed the asphalt blocks are laid by workmen standing upon the pavement previously laid, the joints being broken 4 in. A skilled corps is required for this work and the amount of pavement placed by one layer is remarkable, 600 sq. yd. being a good day's work. This represents the actual placing of 70 to 100 tons of material, according as 2 or 3-in. blocks are being used. After being laid, the blocks are given a light coat of sharp, screened sand which is broomed into the joints. Within three or four days traffic is permitted, which in the summer season soon seals up the joints and makes the surface waterproof.

Composition of Blocks

Asphalt blocks, as used in New York State highways, are 12x5x2 in. in dimensions. The proportions of the ingredients are varied to suit different conditions such as temperature of the locality and character of the materials used. An average proportion is about 70 per cent crushed rock, usually trap which has passed through a ¼-in. ring, sufficient limestone dust, approximately 20 per cent, to insure a dense mixture and to absorb the usual 10 per cent of asphaltic cement. As Trinidad asphalt is used, this results in a bitumen content

TWO-INCH ASPHALT BLOCK ON 4-INCH CONCRETE BASE IN RYE



DETAIL OF ANTI-SKID JOINT

of about 7 per cent. These materials are heated to 300 deg. Fahr., thoroughly mixed, and shaped into blocks under the enormous pressure of 500 tons per square foot. It is a curious fact that this material may be held in the hand before it is shaped without experiencing much sensation of heat, if it is clasped tightly, however, a serious burn will result.

The percentage of asphaltic cement noted above is greater and the penetration thereof higher than was formerly used in asphalt block manufacture. This has been required in order to obtain a block of greater pliancy than before, as the older types tended to crumble at the edges and to break under heavy loads.

The use of this different quality and quantity of asphaltic cement has resulted in the fact that on grades or on sharp curves where there is an appreciable push on the surface of the pavement by traffic, the blocks have been shifted from their original positions. This caused the joints to open at certain places to such an extent that the upper edges of the blocks crumbled.

In order to overcome this movement, it was decided to place strips of steel across the road at intervals of about 25 ft. These strips were made in lengths of 2 ft. for convenience in handling and were $1\frac{1}{2}$ in. wide and 3-16 in. thick. They were placed on edge between two rows of blocks and embedded $\frac{1}{2}$ in. in the mortar cushion.

ANTI-SKID JOINTS

Practice showed that the space of 25 ft. between the anti-skid joints, as they are called, was too great effectually to prevent the slipping of the pavement upon its base. Finally, one of the manufacturers evolved the idea of incorporating steel in the blocks, allowing it to project $\frac{1}{2}$ in. below the surface for the purpose of obtaining a bond with the mortar bed. This idea was carried out by pressing into some of the block delivered strips 22 x 1 x 1/16 in. in the manner indicated in the accompanying drawing. It will be noticed that there is a break in the continuity of the reinforcement at one end of the block not only for the purpose of providing an outlet for air pressure which would be caused when the block was laid, but also to allow for the unequal expansion between the asphaltic mixture and the steel. A row of blocks treated in such manner is laid across the road at intervals of 15 ft. ordinarily and 10 ft. on sharp curves or steep grades. With this provision there can be no appreciable movement of the surface upon the mortar bed.

CONCLUSIONS

The conclusions deduced from the use of asphalt block pavement for State highways in the metropolitan district are as follows: It presents a smooth, uniform surface, comparatively dustless and noiseless, making it suitable for highways running through residential districts. Its life is variously estimated at from 12 to 18 years, and during that time it wears evenly on account of the uniformity of treatment and composition in the manufacture. Its cost is approximately 10 per cent less than that of brick. It requires no extensive plant at the site of the work for construction or for repairs necessitated by street openings. On the other hand, it has the disadvantage of becoming very slippery when subjected to a fine, slow rain which is insufficient to wash the surface clean of oil drippings. This is obviated to a certain extent by periodically sanding the surface lightly.

In the latter part of 1913 several French and Belgian engineers visited this country and investigated the merits of this type of pavement on New York State highways. As a result of their findings it was decided to erect an asphalt block manufacturing plant at Mons, Belgium, for the purpose of supplying material to resurface the intercity routes of Belgium, which are at present principally of the old Belgian block type. A boat-load of asphalt had been shipped from Trinidad to start operations when the present European conflict broke out. In view of the fact that these roads are being subjected to extraordinary wartime traffic, especially the heavy siege guns which weigh approximately 30 tons, it is quite likely that this plant will be taxed to its utmost for some time after the cessation of hostilities.

Steel Bridge Standards of the Iowa Highway Commission

Types of Structure Adopted Include I-Beam Spans, Pony Trusses of Two Kinds, and Through Trusses—Sliding Shoe Provides for Expansion

By E. F. KELLEY
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ONE of the duties which the new Iowa road law, passed in 1913, imposed upon the State Highway Commission was the furnishing of standard plans for bridge and culvert construction to the various counties of the state. Since the passage of the law and the creation of the highway commission the work of preparing the required standards has progressed rapidly and a great deal has already been accomplished. The standards for concrete bridges were described in an article in the Engineering Record of Nov. 7, page 514.

In the standardization of steel bridges, the various limiting conditions have reduced the types of bridges which may be used to advantage to a very small number. The small amount of headroom available in most sections of the State eliminates at once any standard deck spans. The difficulties of transportation and erection eliminate plate-girder spans except in special cases where the distance from the shipping point is short. Comparatively few bridges of a greater length than 90 ft. are required and where the length exceeds this figure it is generally more economical, on account of the limited headroom and low piers and abutments, to use short spans rather than long ones. While they are in

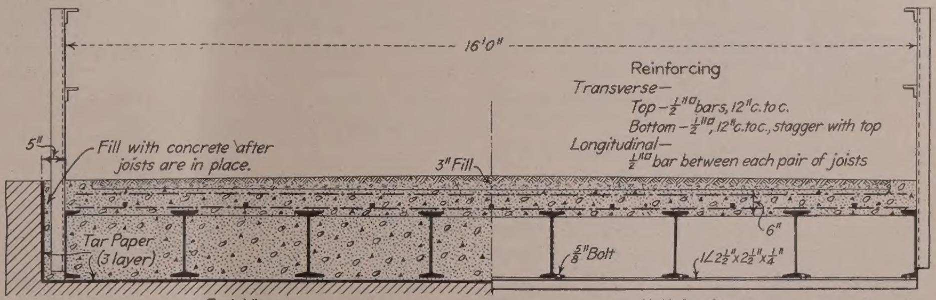

16'0"
Reinforcing
Transverse—
Top—½"□ bars, 12" c. to c.
Bottom—½"□, 12" c. to c., stagger with top
Longitudinal—
½"□ bar between each pair of joists
5"
Fill with concrete after joists are in place.
3" Fill
6"
Tar Paper (3 layer)
⅝" Bolt
1∠ 2½"x2½"x¼"
End View
Half Section

FIG. 1—CROSS-SECTION OF STANDARD BEAM SPAN WITH CONCRETE FLOOR

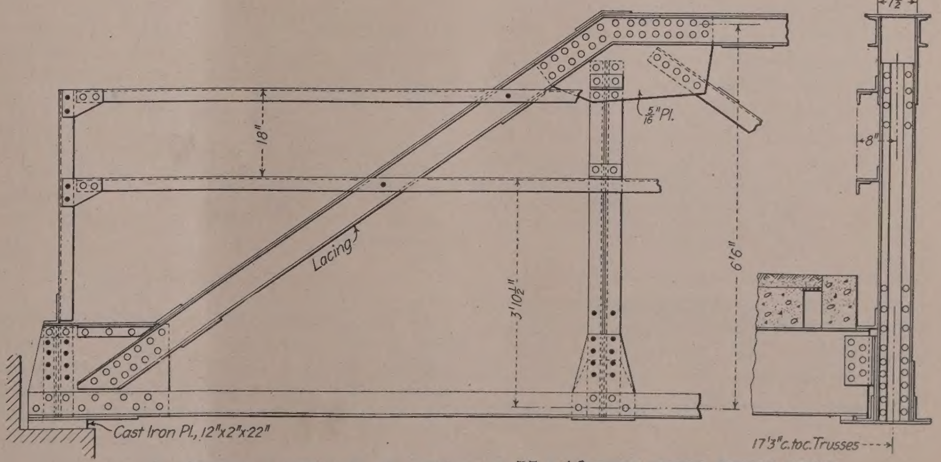


FIG. 2—GENERAL DETAILS OF STANDARD 55 X 16-FOOT PONY TRUSS SPAN

the minority there are required, however, enough spans exceeding 100 ft. to warrant the preparation of standard designs for spans up to and including 150 ft. For greater span lengths all designs are special.

The matter of floors is, of course, an important one and in view of the general conditions in the State it was deemed advisable to make all steel bridges heavy enough to carry concrete floors. The maintenance of timber bridge floors is a constant drain on the county bridge funds and the tendency is to eliminate them as much as possible.

Types Adopted

In view of these considerations the following types were adopted for the standard designs:

I-beam spans with 16, 18 and 20-ft. roadways for spans from 16 to 32 ft. inclusive.

Pony trusses with 16 and 18-ft. roadways for spans from 35 to 100 ft. inclusive.

Through trusses with 16 and 18-ft. roadways for spans from 100 to 150 ft.

The I-beam spans are as shown in Fig. 1. Six I-beams and two channels are used for the 16-ft. roadways and seven I-beams and two channels for the 18 and 20-ft. roadways. The beams are held in position at the ends by filling between them with concrete and expansion is provided for by means of tar paper joints.

The pony trusses are divided into two types as follows:—Type 1, riveted Warren trusses with subdivided panels carrying a concrete floor slab directly on the floorbeams as shown in Figs. 2 and 3. Type 2, riveted Warren trusses with full length panels carrying a concrete floor on steel joists as shown in Fig. 4.

The type 1 truss is the one recommended in most cases and, aside from the beam spans, a majority of the steel bridges being built are of this type and of spans from 40 to 70 ft. The type 2 truss is generally used only where a temporary timber floor is desired which is later to be replaced by concrete. In Fig. 5 and the accompanying table are given the estimated quantities for the type 1 pony trusses and other general information in regard to them.

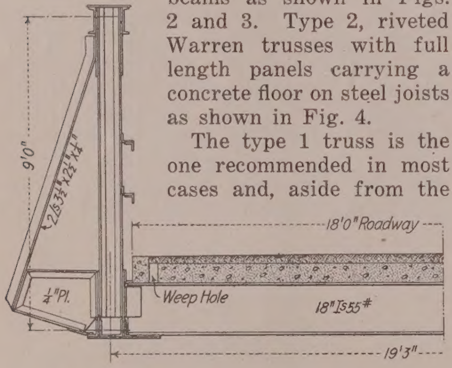


FIG. 3—HALF-SECTION OF STANDARD 90 X 18-FOOT PONY TRUSS SPAN

The high truss spans from 100 to 150 ft. in length are riveted Pratt trusses carrying a concrete floor on steel joists.

Load Assumptions

The standard spans are designed for the following loads:

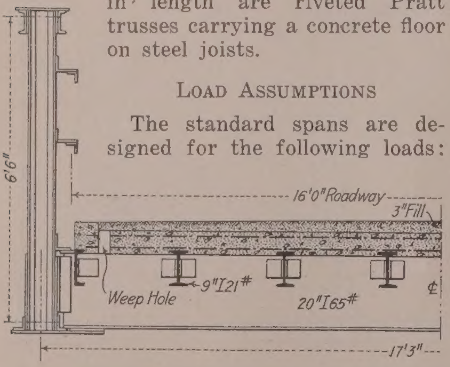
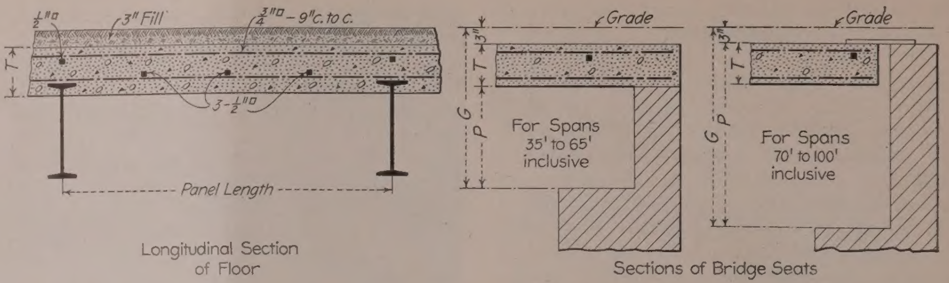


FIG. 4—HALF-SECTION OF STANDARD 50 X 16-FOOT PONY TRUSS SPAN


½"□
3" Fill
¾"□ – 9" c. to c.
T
3-½"□
Panel Length
Grade
T
3"
G
P
For Spans 35' to 65' inclusive
For Spans 70' to 100' inclusive

Longitudinal Section of Floor

Sections of Bridge Seats

FIG. 5—GENERAL DATA AND ESTIMATED QUANTITIES FOR STANDARD STEEL PONY TRUSS SPANS

Span and Roadway, Ft.	Number of design	Height of truss, ft. in.	Number of panels	Center to center of trusses, ft. in.	Thickness of floor, T in.	Bridge seat to grade, G ft. in.	Height of parapet, P ft. in.	Structural Steel, lb.	Floor: Reinforcing, lb.	Floor: Concrete, cu. yd.
35x16	X 1	6–0	4	17–0	8	2–6 15/16	1–7 15/16	12,200	3,470	15.2
35x18	X 2	6–0	4	19–0	8	2–6 15/16	1–7 15/16	12,800	3,880	17.0
40x16	X 3	6–0	5	17–0	7½	2–6½	1–8	15,300	3,940	16.1
40x18	X 4	6–0	5	19–0	7½	2–6½	1–8	16,100	4,400	18.1
45x16	X 5	6–6	5	17–0	8	2–7	1–8	16,700	4,340	19.2
45x18	X 6	6–6	5	19–0	8	2–7 1/16	1–8 1/16	17,500	4,860	21.5
50x16	X 7	6–6	6	17–3	7½	2–6⅝	1–8⅛	19,900	4,820	19.9
50x18	X 8	6–6	6	19–3	7½	2–6 11/16	1–8 3/16	21,000	5,370	22.3
55x16	X 9	6–6	6	17–3	8	2–7¼	1–8¼	21,400	5,230	23.2
55x18	X10	6–6	6	19–3	8	2–7 3/16	1–8 3/16	23,100	5,830	26.0
60x16	X11	7–0	7	17–3	8	2–7⅛	1–8⅛	25,500	5,850	25.2
60x18	X12	7–0	7	19–3	8	2–7 3/16	1–8 3/16	27,200	6,540	28.3
65x16	X13	7–0	8	17–3	7½	2–6 11/16	1–8 3/16	29,100	6,310	25.5
65x18	X14	7–0	8	19–3	7½	2–6¾	1–8¼	31,000	7,060	28.7
70x16	X15	7–0	8	17–3	8	3–3½	3–0½	34,700	6,580	28.5
70x18	X16	7–0	8	19–3	8	3–3 9/16	3–0 9/16	36,900	7,350	32.0
75x16	X17	7–6	9	17–3	7½	3–3⅛	3–0⅛	39,400	7,040	28.6
75x18	X18	7–6	9	19–3	7½	3–2 13/16	2–11 13/16	41,700	7,870	32.1
80x16	X19	8–0	10	17–3	7½	3–3⅛	3–0⅛	43,800	7,500	30.5
80x18	X20	8–0	10	19–3	7½	3–2⅞	2–11⅞	46,600	8,380	34.3
85x16	X21	8–6	10	17–3	8	3–3 5/16	3–0 5/16	47,100	7,920	34.5
85x18	X22	8–6	10	19–3	8	3–3 7/16	3–0 7/16	49,400	8,840	38.8
90x16	X23	9–0	10	17–3	8	3–3⅞	3–0⅞	50,200	8,490	36.5
90x18	X24	9–0	10	19–3	8	3–3 15/16	3–0 15/16	52,800	9,490	41.0
95x16	X25	9–6	10	17–3	8	3–3 15/16	3–0 15/16	52,400	8,910	38.5
95x18	X26	9–6	10	19–3	8	3–6	3–3	59,200	9,960	43.2
100x16	X27	10–0	10	17–3	8½	3–4 7/16	3–1 7/16	57,200	9,310	43.0
100x18	X28	10–0	10	19–4	8½	3–6½	3–3½	64,000	10,400	48.3

Dead Load, which includes weight of steel, concrete floor and a 3-in. earth fill.

Live Load, a uniform load, per square foot of roadway, of 100 lb. for spans up to 50 ft.; 90 lb. for spans from 50 to 100 ft.; and 80 lb. for spans from 100 to 150 ft. The following assumptions were made for a concentrated load consisting of a 15-ton traction engine:—10,000 lb. on front wheels; 20,000 lb. on rear wheels; distance between front and rear axle, 11 ft.; distance, center to center, of rear wheels, 6 ft.; width of rear wheels, 22 in.

Bituminous Cushion Recommended

In connection with the 3-in. earth fill mentioned under "dead load," a bituminous cushion coat for the concrete floor is recommended, where possible, in place of the fill.

The concrete floor slabs on the type 1 pony trusses are designed as continuous double reinforced beams, the engine wheels being assumed to have a lateral distribution of 4 ft. In designing the standard I-beam spans and the floor joists for truss spans each engine wheel load is assumed to distribute over three joists for concrete floors and over two joists for wood floors. Tests which are being carried on jointly by the Engineering Experiment Station of the Iowa State College and the Iowa Highway Commission, although not yet complete, indicate that the above assumptions are approximately correct.

Sliding Expansion Shoes

In the design of the standard trusses it has been the intention to secure as great rigidity as is consistent with economical design. No pin-connected trusses are used for bridges having a span length of less than 150 ft. and rod lateral bracing is not allowed in any case. The vertical posts in all pony trusses are built of four angles with a web-plate, and pony trusses of spans over 65 ft. are braced by outside brackets as shown in Fig. 3. On spans of 65 ft. and less expansion is secured by means of a sliding shoe. Above 65 ft. all spans have pin bearing shoes and expansion is provided for by a rocker shoe as shown in Fig. 3. This type of expansion rocker is used in preference to circular or segmental rollers for the reason that less trouble is encountered due to clogging with dirt. The floorbeams of all standard trusses are rolled beams and end floorbeams are provided in all cases.

It is required that shop drawings for all bridges be approved by the highway commission and in this connection it was early discovered that ordinary stress sheets with no general details were not satisfactory either to the commission or to the contractors. For this reason on all standard and special designs prepared by the commission sufficient details are given to show clearly the type of construction required. With these general details and the standard specifications the weights of the various spans can be very accurately estimated and shop drawings prepared which will be acceptable to the commission.

ASPHALT PAVING AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION is now well under way and the laying of the final 1,000,000 sq. ft. on the main avenue of the grounds has been begun. This is in addition to the 1,500,000 sq. ft. of asphalt already in place and exclusive of about 2,500,000 sq ft. of macadam paving throughout the courts, footpaths and smaller streets. On the main avenues encircling the palaces where the automobile races will be held, and at the main entrances, the asphalt will be 1½ in. thick. Elsewhere it will be 1 in.

Practical Hints on Proper Methods of Maintenance for Concrete Pavements

Experiences of Several Cities in Repairing Cracks and Poorly Made Joints—Patching Large and Small Holes—Bituminous Specifications

By WILLIAM M. KINNEY, Chicago, Illinois

SUCCESS of concrete pavement is based on the durability and low cost of maintenance of this type of construction. The life of the pavement is dependent on careful maintenance, small though it be in cost. Such maintenance must also be consistent. A teaspoonful of tar and a handful of sand in a hole caused by the presence of a lump of coal or wood in the aggregate will prevent further wear for several years. If such a hole is allowed to wear to a depth of 2 or 3 in. the repair becomes a more complicated problem.

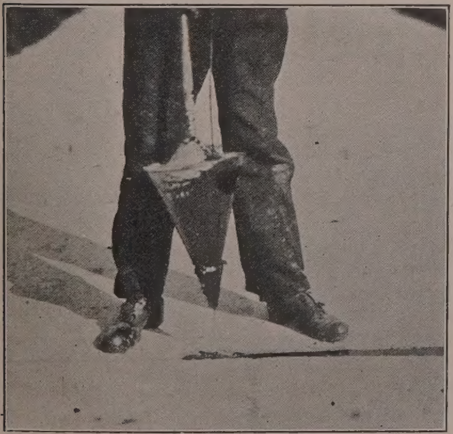
CRACKS AND JOINTS

So it is with cracks and poorly made joints. Wherever repairs are required they should be made promptly and thoroughly. Minneapolis has recently set an excellent example by completing repairs of expansion joints, cracks and imperfections in all of the concrete pavements laid in that city during 1912 and 1913. The method of doing this work consisted in brushing out the joints and cracks with an ordinary street broom and a whisk broom, after which the openings were filled with Tarvia X and dry sand applied to the surface.

During the last week of September Church Street Road, west of Evanston, Ill., was thoroughly repaired by pouring hot tar into the holes and cracks, after which a mixture of 1/8-in. torpedo sand and 1/4-in. granite screenings was spread over the tar. Careful records of time and material show the cost of repairs on this road to have been only $0.0034 per square yard.

Wayne County, Michigan, after cleaning cracks with wire brooms, fills them with tar heated to 225 deg. Fahr., allowing it to stand for a few minutes to prevent bubbling, then covering with dry, coarse sand spread from a shovel. Pit holes are treated similarly. By using an excess of tar and allowing traffic to "iron" the surface, adjoining edges of the concrete are prevented from chipping.

With reference to the selection of suitable tar filler, Wayne County, Michigan, now uses Tarvia X. The manufacturers recommend a mixture of Tarvia X and stone for filling holes exceeding ½ in. in depth; and for smaller depressions and cracks, a mixture of sand and the lighter product known as Tarvia A.



APPLYING BITUMINOUS FILLING

Worcester, Mass., has some pavement patches which have been in service several years where repairs were made by using a mixture composed of 1 cu. yd. of sand and 40 gal. of refined tar. After cleaning and drying the hole, the bottom and sides were given a thin coat of hot tar. Then the warm mixture was placed, tamped, dusted with sand and cement, and rolled.

Cambridge and Somerville, Mass., have successfully used the penetration method of patching, and Windsor, Ontario, is now repairing in a similar manner. After cleaning, drying and painting with hot tar, holes are filled with stone of selected sizes. Refined tar is then poured in to occupy the voids and to fill the holes level with the surrounding surface, after which pea gravel is spread on top and the patch rolled.

FINISHING REPAIR OF JOINT

BITUMINOUS SPECIFICATIONS IN OHIO

In Ohio, the State Highway Department has been using a coal-tar pitch filler, locally known as bituminous material F2, having a specific gravity varying from 1.23 to 1.33 at 25 deg. C. Ohio experience indicates that this preparation is somewhat heavier than necessary and that where the defect to be repaired is not more than 1 or 2 in. deep, the lighter refined coal-tar, known as bituminous material T1, which has a specific gravity varying from 1.18 to 1.25 at 25 deg. C., would be sufficiently heavy. Complete specifications covering Ohio's bituminous material T1 are as follows:

1. The tar shall have a specific gravity of not less than 1.18 nor greater than 1.25 at 25 deg. C. (77 deg. Fahr.).

2. On extraction with carbon disulphide, it shall not contain more than 20 per cent nor less than 8 per cent free carbon.

3. Upon ignition it shall not show over 0.5 per cent inorganic residue.

4. The index of consistency as determined by the Howard & Morse float apparatus at a temperature of 50 deg. C. (122 deg. Fahr.) shall not be less than 2 min. nor more than 3 min.

5. When distilled by the method proposed by the American Society for Testing Materials, it shall yield no distillate at a lower temperature than 170 deg. C. (338 deg. Fahr.), not more than 10 per cent shall distill below 270 deg. C. (518 deg. Fahr), and not more than 20 per cent shall distill below 300 deg. C. (572 deg. Fahr.). The specific gravity of the entire distillate shall be not less than 1.03 at 25 deg. C. (77 deg. Fahr.). The residue from the foregoing distillation shall have a melting point not greater than 75 deg. C. (167 deg. Fahr.) by the cube method.

CLEANING OUT CRACKS

6. The tar shall be free from water and shall not foam when heated to 300 deg. Fahr.

Where the defect to be repaired extends through the pavement and exceeds 6 in. in breadth or diameter, tar should not be used but the opening should be filled with concrete, care being taken first to remove all loose particles by brushing. The sides of the hole should be painted with cement grout before depositing concrete. Although replacement following excavation for laying or repairing city gas, water or sewer mains, and electric or other conduits, cannot justly be charged as an item of repair, it is nevertheless worthy of consideration on account of its close relation to the present subject.

REPLACING CUT PAVEMENT

Fond du Lac, Wis., has had considerable experience in replacing pavement cut out for installing gas and water service pipes as well as telephone conduits. J. S. McCullough, city engineer, reports that after the excavations were brought to pavement subgrade by backfilling with gravel, sand or crushed stone, the edges of the hole were trimmed so the walls of the cut would be as nearly vertical as possible and the hole was then filled with concrete mixed in the same proportions and consistency as the original pavement. Patches were finished in the same manner as the original work and traffic kept off until the concrete had hardened. These repairs or replacements cost slightly less than similar replacements of brick laid in cement mortar.

RECOMMENDATIONS

Based upon present practice, the following recommendations are consistent:

1. The imperfection to be repaired should be thoroughly cleaned by brushing until all loose particles have been removed.

2. If the imperfection extends through the pavement and exceeds 6 in. in breadth or diameter, the sides should, after cleaning, be painted with cement grout, and the cavity filled with concrete of the same mix-

ture and consistency as were used in building the original pavement. If a replacement, the excavation should be backfilled with gravel, well tamped, and the concrete properly reinforced. The repaired portion should be cured by being kept moist for at least four days, and protected from traffic until thoroughly hardened.

3. When a hole does not extend through the pavement but exceeds ½ in. in depth, it should be carefully cleaned and dried and then painted with hot tar. The hole is then filled with stone. Several sizes should be carried by the repair gang, the object being to use in any given hole a size of stone large enough to reach nearly from the bottom of the hole to the surface, but never to use stone exceeding 2½ in. in diameter. Where large sizes of stone are used, voids should be carefully filled with smaller sized stone and the whole tamped or rolled into place. Hot tar is then poured over the patch, gaging the quantity so the tar will be absorbed without any large excess.

4. Holes less than ½ in. deep, cracks less than 1 in. wide, and expansion joints from which the filler has wholly or partly disappeared, should be cleaned, dried and filled a little above level with hot tar, on the surface of which gravel or granite, from ⅛ in. to ¼ in. in size, should be spread from a shovel.

5. Refined coal tar should be used, having a specific gravity not less than 1.18 nor more than 1.25 at 77 deg. Fahr. The tar should be heated to from 225 deg. to 250 deg. Fahr. at the time of application and may be applied by means of the conical apparatus illustrated, or by using a sprinkling can. Sand or screenings graded from ⅛ in. to ¼ in. should be spread over the surface before the tar has cooled enough to prevent the sand from becoming firmly embedded therein to form a permanent wearing surface.

Stone-Filled Asphalt Surface or Fine Asphalt Concrete

Experience with Mixture Laid in Sixty-five Cities —Best Methods of Construction and Deficiencies in Existing Work

By CLIFFORD RICHARDSON
Consulting Chemical Engineer, Barber Asphalt Paving Company

IN an article printed in this journal, June 29, 1912, the writer discussed, under the title "The So-Called Topeka Surface for Highways," a paving mixture which had been held by Judge Pollock of the U. S. District Court for the District of Kansas not to be an infringement of the claims of the well-known Warren patent. The article showed that the grading specified for the finer part of the mineral aggregate was necessarily undesirable, pointing out at the same time that the essential feature of the decision was that a material of a size larger than that which passes a 10-mesh sieve should not exceed certain percentages, and that a satisfactory mixture would be obtained by providing for a grading of the finer portion, such as that of the standard sheet asphalt surface. A mixture of this type has attracted a great deal of attention during the last two years, and it has been laid extensively in at least sixty-five cities. The experience therewith is of some interest, and we are now in a position to demonstrate how such a surface can be laid in the most satisfactory manner, and where certain deficiencies lie in work that has been constructed.

Table 1—Proportions in Asphalt Concrete Surface on Riverside Drive, New York.

Composition			A	B
Asphalt cement	110 lb.	Bitumen	8.9	11.1
Portland cement dust.	110 lb.	200 mesh	11.9	16.5
Sand	312 lb.	80 mesh	14.5	20.1
Stone screenings.....	564 lb.	40 mesh	18.6	25.9
		10 mesh	18.9	26.4
	1096 lb.	4 mesh	19.1	
		2 mesh	8.1	
			100.0	100.0

Table 2—Mixture Used at Rochester, N. Y.

Composition	Original mixture	Finer portion
Bitumen	8.9	11.1
200 mesh	12.3	17.1
100 and 80 mesh................	10.8	15.0
50 and 40 mesh..................	24.2	33.7
30, 20 and 10 mesh..............	16.3	22.7
4 mesh	21.5	
2 mesh	5.4	
	99.4	99.6

The finer part of the mixture may consist either of properly graded sand, the finer portion of crushed rock of proper grading, or a mixture of the two, the rock screenings consisting of that portion of crushed rock which passes a screen of two meshes to the inch. As far as experience has gone the mixtures which have been constructed with screenings, including the fine material, are as satisfactory as those made with sand and clean stone free from the finer portion.

Table 3—New Jersey Mixture

Composition			Original mixture	Finer portion
Asphalt cement...........		Bitumen	8.1	10.6
	105 lb.	200 mesh	8.9	13.1
Dust	80 lb.	80 mesh	10.7	15.8
Sand	560 lb.	40 mesh	25.3	37.3
Stone screenings ..	370 lb.	10 mesh	15.7	23.2
		4 mesh	13.0	
	1,115	2 mesh	17.3	
Retained by		2 mesh	1.0	
			100.0	100.0

Table 4—Ontario Mixture

Composition			Original mixture	Finer portion
Asphalt cement....	135 lb.	Bitumen	9.7	10.7
Dust	70 lb.	200 mesh	8.3	9.6
Sand	700 lb.	80 mesh	13.0	15.1
Stone screenings...	200 lb.	40 mesh	46.5	54.1
		10 mesh	9.0	10.5
	1,105 lb.	4 mesh	6.0	
		2 mesh	7.5	
			100.0	100.0

Typical of such a fine asphalt concrete surface is that which was laid on Riverside Drive in New York in the autumn of 1913, data in regard to which are shown in Table 1, in which column A gives the average composition of the surface mixture as laid on the street, and column B that of the finer portion, excluding the particles of 4 and 2-mesh size and the bitumen, 4 per cent, which is regarded as sufficient to cover them. These figures demonstrate what the character of the finer portion of the mixture is, regarded as a sheet asphalt surface, to which the stone or grit size has been added. It is seen that this is very satisfactory from that point of view, containing a proper percentage of bitumen and filler, although the material passing a 10, 20 and 30-mesh sieve is high. It is to be noted that the mixture is much improved by the fact that the filler was Portland cement. It seems reasonable to believe that this surface may be regarded as the highest type of one that is stone-filled or known as fine asphaltic concrete. The results developed by service tests will be of interest.

In this connection it is worthy of observation that a mixture of this type is being laid in Rochester, N. Y., at the present time and has been so used for twelve years. The Rochester mixture closely resembles that on Riverside Drive, containing Portland cement as a filler, and has proved itself by service tests, since the date given, to be entirely satisfactory. This mixture, as put down by Whitmore, Rauber & Vicinus, contractors of that city, has the composition shown in Table 2.

Table 5—Georgia Mixture

Composition			Original mixture	Finer portion
Asphalt cement....	160 lb.	Bitumen	7.7	9.6
Dust	60 lb.	200 mesh	6.8	10.1
Sand	9 cu. ft.	80 mesh	15.0	22.4
Stone screenings..	9 cu. ft.	40 mesh	17.0	25.4
		10 mesh	21.8	32.5
		4 mesh	19.5	
		2 mesh	12.2	
			100.0	100.0

Table 6—Kentucky Mixture

Composition			Original mixture	Finer portion
Asphalt cement....	140 lb.	Bitumen	8.4	13.5
Stone screenings...	400 lb.	200 mesh	3.4	5.5
Sand	600 lb.	80 mesh	2.5	4.0
		40 mesh	26.0	41.7
	1,140 lb.	10 mesh	22.0	35.3
		4 mesh	20.0	
		2 mesh	17.7	
			100.0	100.0

As examples of stone-filled or asphaltic concrete mixtures laid in other parts of this country, the figures shown in Tables 3 and 4 may be regarded as satisfactory, while less satisfactory results have been obtained in the localities mentioned in Tables 5 and 6. The last two mixtures are open to comment because the one from Georgia is deficient in bitumen, while that from Kentucky is strikingly deficient in filler and fine sand. It may be noted that all of these mixtures are prepared with Bermudez asphalt cement.

From the wide extent to which mixtures of this type have been laid in this country it is evident that they have attracted much attention. Where laid with skill and care they present, in the light of the limited service to which they have been exposed, very desirable characteristics. From the writer's experience he is led to believe that there is a great future for this type of construction. It is to be regretted that such long time service tests are necessary to demonstrate the true value of any road surface, it being impossible to determine this until the surface is worn out and the amount of service which it has rendered ascertained. Until the fine asphaltic concrete pavement has been in use for 15 or 20 years, unless it goes to pieces in the meantime, it will be impossible to pass a final verdict upon its merits. It seems probable to the writer, however, that this verdict will be a favorable one.

The Strength and Design of Washers with reference to their bearing on wood have been investigated by L. R. Rodenhiser at Cornell University. The object of the investigation was to determine the safe bearing values and ultimate strengths of different woods under different washers and the economic sizes and weights of washers. The three main conclusions were: (1) For bolts of less than ½ in. in diameter no reinforcement of the washer is necessary, a flat plate large enough to provide sufficient bearing area being all that is required; (2) for each inch of diameter of the plate there should be a height of 3/16 in. for the spool, but no spool should be less than ¼ in. in height; (3) for each inch of diameter of the plate there should be a thickness of 1/16 in. for the spool, but no spool should be less than 3/16 in. in thickness.

Expenditures for Permanent and Perishable Features of Roads

Percentages of Total Cost Which Should Be Applied to Foundations, Drainage Structures, Alignment and Grades

THE importance of distinguishing carefully between the permanent and the perishable features of a road for which money raised by the sale of highway bonds is to be expended, is emphasized in bulletin 136 of the U. S. Department of Agriculture, entitled "Highway Bonds," the source of the following notes: Foundations, drainage structures, alignment and grades, are permanent features which should be looked upon in the light of an investment. If these features do not comply with a certain standard it will be poor economy, according to the bulletin, to spend money on transitory improvements such as hard surfaces, which must be renewed at considerable expense from year to year.

MINIMUM STANDARDS

Local conditions, of course, determine to a great extent the proper standards for the permanent features of any highway. Twenty years' experience in modern road building has shown, however, that there is a minimum which any road built on borrowed money should comply with. A close study of 244 different types of road shows that to meet this minimum standard the sums in the accompanying table will probably have to be expended for three standard kinds of highways:

MINIMUM EXPENDITURES FOR THREE TYPES OF HIGHWAYS

Type	Drainage and grading	Surfacing	Total	Drainage and grading, per cent	Surfacing, per cent
Gravel (20 ft. wide)	$1,817	$2,599	$4,416	41.15	58.85
Ordinary or water-bound macadam (15 ft. wide)	3,400	5,815	9,215	36.89	63.11
Bituminous macadam (15 ft. wide).	2,765	7,533	10,298	26.85	73.15

A study of these figures will help counties to avoid the common error of first fixing the sum to be spent and then demanding an exorbitant mileage in return for it. So-called macadam roads have been built with bond money by simply spreading broken stone in the mud. The inevitable result of such shortsightedness is that long before the bonds have been paid off, the improvements for which they were issued have ceased to exist and the county has nothing to show for its increased debt. In the same way, it is manifestly poor policy to build an expensive surface on defective grades with poor alignments and short-lived drainage features.

Even when much of the money expended upon a highway has gone into the permanent features there is still danger that the cost of repairs and maintenance will be overlooked, or at least slighted, in the calculations of the road-builders. When roads are built with borrowed money it is, of course, especially important to avoid this error. On the other hand, it is not necessary to regard the total cost of surfacing a road as a temporary improvement. Much of the surfacing may be classed as a permanent investment, for it is becoming more and more common to have surfaces built in two courses, the lower of which is as much a permanent feature of construction as the grading itself. This is particularly true of those types of road that are built with concrete foundations for bituminous-macadam, brick, or asphalt surfaces. It is probably conservative, indeed, to regard 40 per cent of the surfacing cost of macadam or more enduring pavements as a permanent investment. It is seldom nowadays that hard roads are permitted to wear into the foundation course of the surfacing.

ALLOTMENT OF COST

Probably it is safe to say that an average of about 62 per cent of the total cost of a well-built macadam road should be put into the permanent features, and with bituminous-macadam roads, about 56 per cent. This method of estimating cannot be applied to any gravel or natural soil road in which no part of the surfacing can advantageously be considered permanent, for under most systems of maintenance it steadily deteriorates.

Roads built with surfaces entirely of concrete, or with brick pavements resting on a concrete foundation, are generally regarded as permanent, but it is not yet definitely known how long the best concrete surface will last. The best vitrified brick surfaces may last a number of years, but even with them repairs will be required.

To sum up, the bulletin points out that the initial cost of a road is never the final one; that no surface is permanent, and that repairs and maintenance charges will always be necessary. On the other hand, many features of a good road are to be regarded as permanent investments. When roads are built with borrowed money, the distinction between the permanent and the temporary improvement must be carefully observed, in order that the county may have something in exchange when the time comes to repay the loan.

Behavior of Reinforced Concrete in Fires

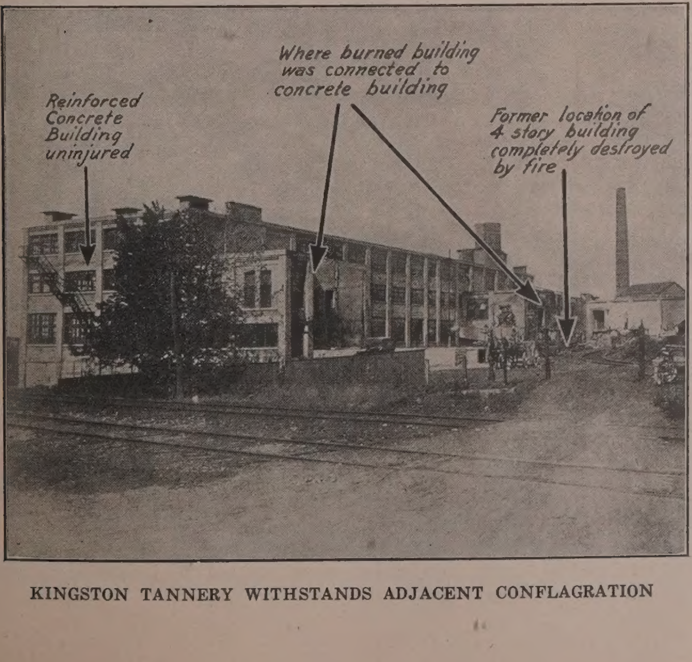
In Three Instances Buildings Were Not Injured by Burning of Inflammable Contents or Destruction of Adjoining Structures

THE ability of reinforced-concrete construction to resist severe fires has been demonstrated in three recent conflagrations, at Kingston, Ont., Youngstown, Ohio, and Kansas City, Mo. In each case the heat was intense and in two of the fires the adjoining structures were destroyed completely.

At the plant of Davis & Sons' Tannery, Kingston, there were two buildings side by side, one a Kahn-system reinforced-concrete structure, the other a brick building with interior wood construction. These two buildings were joined at two points toward the end. The fire completely demolished the brick building, while the reinforced-concrete structure in the midst of the flames was practically uninjured. So intense was the heat that the wire glass in the latter building was melted to a liquid and hung like icicles in various places. The wooden water tank on the top of the structure was reduced to a mass of chars, but has since been replaced. All that remained of the brick building, which was four stories high and filled with leather and machinery, was a mass of scrap iron, steel and brick.

There were also in the fire an engine house and a leach house. The brick walls and wooden roof of the engine house were entirely destroyed. The leach house, which has concrete walls and a wooden roof, shows the concrete walls still standing, while the interior was completely gutted.

In the fire of J. R. Thomas & Sons' whole-


Where burned building was connected to concrete building
Reinforced Concrete Building uninjured
Former location of 4 story building completely destroyed by fire

KINGSTON TANNERY WITHSTANDS ADJACENT CONFLAGRATION

INTERIOR OF YOUNGSTOWN WAREHOUSE AFTER CONTENTS BURN sale warehouse, Youngstown, Ohio, the heat was particularly intense, as the contents were of a highly inflammable nature. The building was about 100 ft. square and six stories high, and at the time of the fire was well filled with stock.

WAREHOUSE FIRE AT YOUNGSTOWN

Two carloads of matches stored at one point of the sixth floor under the roof were reduced to a mass of ashes. These matches burned intensely for three hours, during which the temperature was continuously at about 1700 deg. Fahr. Careful examination of the reinforced-concrete roof above this point showed practically no damage. The bottom of an occasional terra-cotta tile was broken off, but this was readily repaired by metal lath, and plaster.

The cause of the fire, although not exactly known, is believed to have been due to the explosion of rat poison, which simultaneously started the fire on the second, fifth and sixth floors. The explosion was of such violence as to blow out the wall on the south side of the building on the upper two floors, but no damage was done to the reinforced-concrete construction.

The floors and roof consisted of a combination of reinforced concrete and hollow tile. In this system the rows of terra-cotta tile were separated and supported by concrete joists reinforced with Kahn trussed bars. This reinforced-concrete floor was supported on structural steel beams and columns incased in concrete. The floors were designed for a live load of 250 lb. per square foot.

On another part of the floor brooms were stored, some of them being hung from the ceiling and others resting on the floor. So intense was the heat that the handles of these brooms were entirely consumed; but the floor construction showed no signs of damage. Paper bags were piled up to the ceiling on one part of the second floor, and burned fiercely until entirely consumed, yet the only damage to the floor above was to the bottom side of a small area of hollow tile. That the floor itself was not weakened by this intense fire is shown by the fact that above this portion were stored boxes containing canned goods weighing about 300 lb. per square foot. There was no apparent sign of deflection of the ceiling below.

After the débris resulting from the fire had been cleared out, in order to ascertain whether the floor had been weakened in any way by the fire, a test was made. A load of 300 lb. per square foot was placed over the location where the fire had been most intense, and the total deflection of the floor was less than 1/16 in. In this way it was determined that the floors had not been weakened and that they will not have to be replaced. The only repairs required are a slight patching up. The entire concrete construction can, it is stated, be repaired at the expenditure of a few hundred dollars, although the damage to the stock amounted to more than $200,000.

THE KANSAS CITY FIRE

A conflagration occurred recently in the First Christian Church Annex, Kansas City, Mo. The first and second floors of the annex were of reinforced concrete, steel Floretyle construction of the Trussed Concrete Steel Company being used. The upper three floors were constructed of cast-iron columns, steel beams and wooden joists. The building was in course of construction at the time of the fire, and the Hy-Rib ceiling had not been plastered on the under side. Hence the Floretyle construction was subjected to a more severe test than would be expected in a completed building.

The upper three floors of the annex and the church itself were destroyed by the fire. In addition to this the first floor was divided into a number of rooms by wooden partitions which burned up completely, but this additional heat did not affect the construction.

Mechanical Elimination of Seams in Steel Products

Captain Hunt Describes to American Society of Mechanical Engineers New Process of Special Value in Rail Manufacture

INCREASED weight of railway rolling stock and increased speed of traffic have led to increase in size of rail sections, requiring changes in the detail of rail manufacture. Under these conditions new and unexpected physical weakness has developed in the heavier rails. One of the chief troubles has been failures through crescent-shaped pieces breaking out of the rail flanges, followed by at least one, and in many cases several, ruptures across the whole section of the rail. Investigation has shown that in practically every instance of such failure there was a more or less pronounced seam running longitudinally in the bottom of the rail near its center. In a paper, from which these notes are taken, presented last week at the annual meeting of the American Society of Mechanical Engineers in New York City, Capt. Robert W. Hunt, of Chicago, described and discussed a method devised by T. H. Mathias, assistant general superintendent of the Lackawanna Steel Company, for the mechanical elimination of such seams.

Mr. Mathias determined that the most certain way of getting rid of seams was to remove that portion of the metal which contained them. He reasoned that the primary causes of seams existed in the ingots and probably were incident to the casting of them. The surfaces of ingots display disk-like apertures, due to entrapped air, which in rolling could easily be elongated into dangerous seams. It was demonstrated, also, that the surfaces of the ingots are decarburized to the extent of eight or ten points carbon and to a depth of 5/16 in., which must be detrimental to the finished product.

PROCESS

The removal of the surface metal is effected by a hot sawing or milling operation during the process of rolling. The ingot is reduced in the blooming rolls to an 8 x 8-in. cross-section and after cropping the ends the bloom is further reduced in the roughing or shaping stand of rolls by five passes. When it leaves these rolls, it is approximately 75 per cent finished and at this period it is carried to the right and entered between two pinch rolls with its base or flange side up. A bar which will make four 33-ft. rails is at this point in the rolling operation about 60 ft. in length; therefore, the area of metal to be cut off or removed in the milling machine is approximately ⅛ in. deep, 7 in. wide and 60 ft. long. It is driven through the pinch rolls at a rate of 60 ft. in 30 seconds. The pinch rolls have a draft of about ⅜ in. and thus force the bar between the two milling saws, which are so arranged in the housing that they may be raised or lowered as desired. There is from 1/32 to 3/64 in. of metal milled from the head and base of the bar, the front end of which, immediately on passing from between the rolls, is caught by a second set of pinch rolls which have a draft of about 1/16 in. These pinch rolls force the bar between the tools, pull it from between them, and also hold it in practically perfect line for the milling operation. The milling apparatus is driven electrically and requires about 600 hp for its operation.

Either by a modification of the shape of the piece as presented for treatment in the milling machine, or, what will probably be more practical, by changing the face of the tool, the milling can be extended to the extreme edge of the flange portion of the bar and somewhat around the corners of the top or head side. This will undoubtedly be perfectly practical and will thereby eliminate the seams which may be located in those parts of the bar. Such elimination is not accomplished at present, and perhaps it may not be necessary. The primary object of Mr. Mathias was to eliminate the seams from the central portion of the bottom of the rail which had been the starting point of the moon-shaped failures, and to remove them from the top or bearing surface of the head of the rail. Captain Hunt thinks, however, that it will be desirable to extend the milling by the use of convex-faced tools.

The work of rolling which the steel receives after the removal of the more or less laminated metal must produce a better product than if such elimination had not taken place, and, in the case of steel rails, it should not only make them less liable to breakage on account of seams in their flanges, but also enable them better to resist the abrasive effects of traffic.

IMPORTANCE OF METHOD

The surfaces of practically all rails, when etched, will show some seams on both base and head, and very frequently the extent of such defects will not be appreciable if the scale had not been removed. Even then, it is not always an easy or certain matter to estimate the depth of the seams. When the rails have been subjected to the Mathias milling operation and still show pronounced seams, it has been found that breaking tests will practically always develop the fact that the suspicious marking is an actual seam. As the original defects on the sides of the ingots vary in extent, so will the character of the resulting seams vary, and it can be readily appreciated that some of them may have been too deep to have been completely eliminated by the milling.

"While I have confined myself to the matter of steel rails," states Captain Hunt in conclusion, "it is patent that the process will be of great value in the preparation of blooms for axles and all other kinds of forgings. As is well known, it is practically the universal custom to endeavor to remove the seams developed in rolling axle billets by chipping them out through the use of pneumatic hammers, and for some of the higher characters of forgings, notably for automobile parts, the endeavor to eliminate the seams is carried to the extent of turning off the whole surface of the billets. I am confident that by the Mathias plan the greater part, if not all, of such work can be superseded, and I regard the invention and its practical installation as a notable achievement in the art."

Discharge of Water Through Nozzles

Derivation of Formula for Use with Slide Rule and Adapted to Introduction of Any Efficiency Factor Desired

By F. W. L. PEEBLES
St. Louis, Missouri

NEARLY every handbook used by engineers gives data concerning the flow of water through nozzles and tables for the delivery at the usual pressures and for the usual sizes of nozzles. Providing the efficiency of the nozzle in question is the same as the efficiency provided for in the table no question arises. However, a well constructed formula that may be used in conjunction with the ever-present slide rule is capable of serving all the purposes of the table with the advantage that any efficiency factor desired may be incorporated. With the end in view of constructing such a formula the present analytical development has been undertaken. In establishing the theoretical flow no attention has been given to the effects due to *vena contracta*, or the other effects due to friction or to the varying viscosity of the fluid due to variation in temperature. These matters are best incorporated in the factor used to correct for efficiency.

Owing to the fact of the velocity of discharge being theoretically the same as the velocity of a body freely falling from the water level to the center of the orifice, it is common practice to refer to the operating pressure in feet of head rather than in pounds per square inch. Since these pressures are generally determined by a pressure gage our formula is made with reference to gage pressures. The ratio between gage pressure and head has about as many different expressions as there are authors. Using 62.4245 lb. per cubic foot for the weight at maximum density, however, and correcting according to Kopp for expansion to 61 deg. Fahr., the ratio is 1:2.309, and if this is shortened to 1:2.31 we have a very convenient factor. Therefore, in this work a 2.31-ft. head is considered as equivalent to 1 lb. per square inch.

TRAFFIC SIGN IN POSITION

The velocity v, in feet per second, of a body falling *in vacuo* is

$$v = \sqrt{2gh} \qquad (1)$$

Replacing h for the gage pressure p, and introducing its constant,

$$v = \sqrt{2 \times (2.31 \times g \times p)} \qquad (2)$$

and reducing this to inches per second,

$$v = 12\sqrt{2 \times (2.31 \times g \times p)} \qquad (3)$$

But the volume Q per second expressed in cubic inches where all other dimensions are inches is

$$Q = va \qquad (4)$$

where a is the area of the orifice. For nozzles that are circular and where their diameters are expressed in eighths of an inch, a becomes $0.7854\ (d/8)^2$. Replacing both v and a in equation (4) by their equivalents,

$$Q = 12\sqrt{2\ (2.31gp)} \times 0.7854d^2/64 \qquad (5)$$

Reducing this to gallons per minute,

$$Q = 12\sqrt{2\ (2.31gp)} \times 0.7854d^2/64 \times 60/231 = 0.46653d^2\sqrt{p} \qquad (6)$$

This holds for round orifices under p pounds pressure, the diameters being given in eighths of an inch.

KNOCKED DOWN BY AUTOMOBILE

This formula, being calculated on the theoretical velocity of a falling body, assumes that there is no viscosity to the water, and in reality this factor is small and usually negligible. It also assumes that there is no friction or eddy action at the orifice, and this is not negligible. In the case of water flowing through a thin plate the tendency is for the water to flow toward the center of the jet as well as outward. This makes for a decrease in the sectional area of the jet to the extent of about 40 per cent, or to be accurate, a reduction in the diameter to 78.5 per cent. This reduced area, or the *vena contracta*, as it is called, occurs at about one-half the diameter distance from the plate.

Where the nozzle is conical there is an acceleration in the nozzle, and this acts to disturb the balance of pressure. Furthermore, at the discharge end the whole pressure has been transformed into onward velocity so that it is impossible to ascribe any static pressure to the jet. This brings into the case the necessity for the efficiency factor. With the number of different variables that come into the case, the best method of determining this factor is by experiment. With the same general construction and shape this factor is reasonably constant for all sizes likely to be made to one design. The efficiency of different nozzles varies from as low as 62 per cent to as high as 97½ per cent in some experimental work.

In the use of the above formula with the slide rule it becomes convenient to use the factor p last, as by this means it is possible to read the performance of any given nozzle under different pressures quite as easily as from a table. For example, let us assume that we are using a 1⅛-in. nozzle. Our d will be 9 (eighths) and d^2 will be 81. If we now multiply 81 by our constant 0.467 we get the theoretical quantity for 1 lb. pressure. Multiplying this by an efficiency factor, say 90 per cent, our result will be 34.04+ gal. per minute for 1 lb. All of this may be done on the D-scale. If now the 1 of the B-scale be brought to coincidence with 34.04+, pressures p read on B will be in coincidence with the corresponding Q on the D-scale. For those who prefer, it is easy to mark the constant 0.46653 on the D-scale and then by one operation of the slide for d^2 and a second for efficiency we are at once ready to put the pressure scale B into service.

An Automatic "Traffic Squad" at Lawrence

A TRAFFIC sign has been developed by Paul Hannagan, commissioner of engineering, Lawrence, Mass., which has the novel characteristic of recovery from any position after being run over by an automobile or other vehicle. As shown in the accompanying illustrations, the sign consists of a metal column or box 4 ft. high and 6 in. square, attached by a spring to a base casting which fits into a rectangular well 5 ft. deep in the street. The sign normally stands vertically on its pedestal casting, but at night it is inverted and set in the well, the bottom of the base casting forming a cover flush with the road surface. As a device for guiding traffic and separating vehicular movement without failing in its functions because of being struck by some machine or wagon, it lightens the burdens of police duty and is an effective addition to the resources of thoroughfare control. The inventor has applied for a patent on the sign, thirty of which are in use at Lawrence.

OUT OF SERVICE IN STREET PIT

THIRTY-FIVE OF THE PANAMA TOWING LOCOMOTIVES had been delivered up to the end of October, according to the official report of Governor Goethals for that month.

Instructions for Roadway and Track Men on Federal Valuation

Abstract of Second Tentative Draft Recently Issued by Director of Valuation, Interstate Commerce Commission

THE second tentative draft of instruction for the guidance of the roadway and track department of the Interstate Commerce Commission, Division of Valuation, has recently been issued. The director of valuation solicits advice, suggestions and criticisms from all interested parties. All such communications should be filed with the commission not later than Dec. 31. The instructions fill a pamphlet of eighteen pages. Some of the points are here presented in abstract form.

A field corps shall consist of three or more roadway parties directed by a field engineer who shall report to the senior civil engineer in charge of the roadway and track department. The roadway party, which shall be under the personal direction of an assistant field engineer, shall generally consist of three groups—a chaining group, a cross-section group and a computing group.

The chaining group shall generally consist of a recorder in charge, a head chainman and a rear chainman. This party will chain the tracks and locate by station and plus all structures and property, and will inventory ties, rail, track material and fastenings, culverts, small bridges, fences, signs, crossings, small buildings, paving, etc. The cross-section group, which shall generally consist of an instrumentman in charge, a rodman and a tapeman, shall in general measure the grading, ballast, tunnels and subways. There shall generally be two computers with each party.

DUTIES OF PERSONNEL

The senior civil engineer shall be in immediate charge of the roadway department and shall direct the field work as far as practicable through the field engineer. He shall, when practicable, prior to placing a field corps at work, make a general inspection of the property to be inventoried and of the carrier's records pertinent thereto, and shall secure an itemized list of such records.

The field engineer shall direct the work of a field corps through the assistant field engineers. He shall make a sufficiently detailed inspection of the property to be inventoried prior to placing a corps at work to enable him to dispose his forces to the best advantage. He shall also familiarize himself with the records of the carrier relating to the construction, maintenance and cost of the property.

The assistant field engineer shall be in immediate charge of a roadway party. He shall record in a notebook prescribed for the purpose such general and special features of the railway as may be of assistance in the consideration of cost estimates; that is, the general nature of the property and standards of construction and maintenance, location of large borrow pits and unusual length of haul on material in embankments, location of source and haul on ballast, settling of embankments, present condition of the property, etc. Where a railway representative is with a roadway party, the assistant field engineer shall consider with said representative such matters as classification of grading excavation, grading overhaul, haul on ballast, probable character and quantity of hidden construction and property not susceptible of accurate measurement, ownership of property where other owners are involved, actual condition, age, date of creation or installation of property, etc. Where they do not agree the views of each shall be stated and reported to the field engineer.

The roadway party shall locate and note the existence of all property chargeable to "Road" accounts Nos. 1 to 36, inclusive, Interstate Commerce Commission classification, July 1, 1914—detail measurement and inventory to be made in accordance with specific instructions hereinafter. All notes shall be made in duplicate in the standard loose-leaf notebook prescribed for the purpose.

CONDITION OF PROPERTY

The assistant field engineer shall make notes on the condition of all property which it is his duty to inventory. The notes shall generally be made in accordance with the following outline:

Age.—Ascertain where practicable, year of construction, installation or purchase of the property, and whether at that date the property was new or second-hand. If used prior to its present service, give such facts as may be obtained as to length and nature of service elsewhere. Get source of date.

Wear and Decay.—Record such facts as may be practicable from field observations.

Maintenance.—Record whether this is normal; that is, if the standard of maintenance prevailing is such as to secure the average service life out of the property. If the maintenance is above or below normal, give facts on which conclusion is based. Where extensive or unusual repairs are needed to put the property in serviceable condition, note such facts in detail.

Probable Service Life.—Record any local conditions which may operate to shorten or lengthen the service life as compared with average service life of similar property elsewhere. Record any evidence ascertained in the field as to inadequacy or obsolescence.

Abandoned property may be considered as fixed physical property which has been acquired or created by the carriers and used for transportation purposes, and which the carrier has subsequently ceased permanently to use or hold for any of its purposes as a carrier. All notes of abandoned property shall be kept entirely separate from those of property in use.

Special Instructions for "Road" Accounts

Account 2, Land for Transportation Purposes.—The external boundaries of the right of way, as shown on the maps, shall be verified by measurements to fences or other evidences of right-of-way limits, and if no evidence exist the fact shall be recorded. The stationing of changes or other irregularities shall be noted, and sketches made where necessary for irregular parcels.

GRADING

Account 3, Grading.—The grading inventory shall include all work classified under this account, and in addition, separately recorded grading work done for buildings and structures where, in the judgment of the assistant field engineer, such work can best be measured by the cross-section group. Cross-sections shall be made of the roadbed as it now exists in such manner as will permit an active ascertainment of the quantities therein. In general they should be made at each 100-ft. station and at such intermediate points as conditions demand. All ditches constructed by the carrier for whatever purpose shall be estimated. Notes should be made of the kind, and where they are used for other than railroad purposes the conditions governing construction shall be given.

Following the specific instructions of the assistant field engineer, the instrumentman will make notes as to classification of excavated materials, recording, when possible, the lines of demarcation between the different classes of materials in excavations. Unless otherwise instructed all materials shall be classified as solid rock, loose rock or common excavation. Solid rock shall comprise rock in solid beds in its original position which may be best removed by blasting, and boulders or detached rock measuring 1 cu. yd. or more. Loose rock shall comprise detached masses of rock of more than 1 cu. ft. and less than 1 cu. yd., and all other rock which can be properly removed by pick and bar without blasting, although steam shovel or blasting may be resorted to on favorable occasions in order to facilitate the work. Common excavation shall comprise all other materials of whatsoever nature. Where the lines of demarcation are not plain the use of pick and shovel shall be resorted to and every effort made to secure cross-section notes which will permit the calculation of quantities of classified materials. In special cases other classifications may be found desirable.

Where evidence on the ground indicates that the determination at the present time of quantities which have entered into the grading could not be done with the proper degree of decision, the carrier's notes of original construction, where these exist, shall be utilized to assist in establishing the original ground surface. Any figures taken from the carrier's notes shall be inclosed in brackets.

Notes shall be made, where evidence exists, of the acres of clearing and grubbing required, for the original construction. Notes shall be made of the character and quantity of materials entering into retaining walls, riprap, cribbing, artificial sodding, dams, mattresses, bulkheads and similar construction used for supporting or protecting the roadbed. Sketches shall be made where necessary to enable the computation of materials. Notes shall be made of landscape gardening improvements in such detail as to permit of an investigation of their cost.

TUNNELS AND BRIDGES

Account 5, Tunnels and Subways.—Tunnels shall be measured between portal faces and the station and plus of each face recorded. Sketches shall be made of cross-sections, giving dimensions. All changes in cross-sections and the length of the varying sections shall be noted. Portals shall be measured and sketched with sufficient detail to permit the calculation of quantities.

The character and fitness, where practicable, of lining walls, inverts, etc., shall be noted; also the character of ventilation, drainage, amount and character of backfilling, and other similar information pertaining to the actual construction of tunnels as fully as can be obtained. A description, supplemented with sketches in the absence of plans, shall be made of shafts, drains, ducts, etc., sufficient to permit the quantities and materials of construction to be calculated and full notes made of the special conditions affecting the cost under which the tunnel was built. If the present section is an enlargement of the original section this fact should be stated, with such notes regarding the original section as can be ascertained.

Notes should be made of transmission lines, signal apparatus, etc., passing through tunnels, although these will in most cases be inventoried by another department. As far as practicable, the quantities of materials encountered shall be outlined.

Account 6, *Bridges, Trestles and Culverts.*—The roadway party shall locate by station and plus all bridges, trestles and culverts, but shall inventory in detail only such structures as are less than 12 ft. in span, unless otherwise instructed. For all bridges, trestles and culverts there shall be recorded the railroad number where designated, the location by station and plus, the kind of structure and the general dimensions.

TIES

Account 8, *Ties.*—The kind of ties, whether treated or untreated, and whether oak, pine, cedar, fir, etc., together with the dimensions, class and average number per mile, shall be noted. Ties in main lines and sidings shall be listed separately and note made of the kind and class of ties in each track. Notes shall be made whether ties were obtained locally or shipped in, and from where. In order to estimate the number of ties per mile they shall be counted in sections of not less than 600 ft., two sections per mile.

Switch ties shall generally be inventoried by sets. Where the carrier has standard turnouts, notes shall be made of number of switch sets of each type or standard of turnout. The kind of timber and whether treated or untreated shall be noted. Where there are material variations from the standard turnout the exact number of switch ties shall be counted. Note shall be made of all special switch and crossing timber with sufficient detail to permit of estimating costs.

RAILS

Account 9, *Rails.*—Notes shall be made of the weight of all rails and the stations and pluses wherever the weights change in either main or side tracks. Lengths of individual rails shall be made measured at sufficient intervals to determine the standard rail lengths in use. It shall be noted whether the rail is Bessemer, open-hearth or special steel. Where the carrier has no standard drawings showing sections of rail, dimension sketches shall be made where necessary of the sections of different weights of rails. Where obtainable the brand of rail shall be noted from time to time, and information as to age, weight and source. Particular attention shall be paid to rails in both main and side track to secure information as to where the rail was obtained, and whether when laid it was new or relayed.

OTHER TRACK MATERIAL

Account 10, *Other Track Materials.*—In general, rail joints, bolts, spikes, nutlocks, tieplates, etc., in main lines shall be obtained and noted by determining the various track materials in the same 600-ft. sections as the ties. For rail joints there should be shown the kind, weight, maker's brand and number, number and kind of bolts required and number and kind of nutlocks, if any. If the carrier has no plan showing types of rail joints in use, sketches shall be made where necessary to show the different types.

For spikes, the size, average number per tie and total per mile shall be noted; for tieplates the kind, dimensions and weights. It is not necessary for the field party to count the number of each kind of tieplates in a mile, but only to obtain and note that they are mixed kinds. If practicable an estimate may be made of the percentage of each kind. The same sort of notes shall be made for rail braces.

Other track material in side tracks shall be listed separately for each track. Switch points shall be inventoried complete by standard points of different kinds and weights, unless there are missing parts which materially affect the cost of the switch. Frogs shall be classified as rigid, spring, movable-point, etc., and also as to number and weight of rail. Special alloy steel when used shall be noted.

For switch stands notes shall be made of the kind, that is, whether high ladder, high, low or ground throw; the kind of lamp used, if any; the name of the manufacturer and the index number.

Extra spiking on curves and switches, or elsewhere, shall be noted.

Special fixtures which cannot be described by number or otherwise so that they may be identified by catalog or plans of carrier shall be measured and a dimension sketch made where necessary.

The stations and pluses of all main-line switch points shall be noted, and all switch leads, lengths of crossovers, lengths of switches, etc. Lengths of side tracks shall be determined from point of switch to point of switch or to end of track.

BALLAST

Account 11, *Ballast.*—Excavation to determine the cross-section of ballast shall be made at intervals not greater than 1000 ft. where the ballast is of one kind and the section apparently uniform, and a dimension sketch of each section shall be recorded. Such sketches shall also be made at points where the kind of ballast changes or where there are material variations in the ballast section. The stations and pluses of sections taken shall be noted.

Notes shall show kind of ballast (and where two or more materials are encountered in a cross-section the dimension sketch shall clearly show the extent of each kind); quality of ballast; location from which ballast was secured, and if off the line of the carrier under inventory, length of haul to nearest point on line of carrier; and also information as to conditions of handling and loading, where these facts can be obtained.

Where ballast is of a depth in excess of the standard section of the carrier, or, in the absence of such a standard, greater than 18 in. below base of rail, a separation of the excess ballast material shall be made in the computation of quantities.

Account 12, *Track Laying and Surfacing.*—This is a labor item and cannot, therefore, be inventoried, but the assistant field engineer shall note any unusual conditions, if any, which would affect the cost of doing the work.

Account 13, *Right-of-Way Fences.*—This item shall include right-of-way fences, cattle guards, wing fences, aprons and hedges. Other fences around station buildings, shop grounds, stock yards, etc., shall also be inventoried, but shall be classified with the particular buildings or structures to which they apply. Records shall be made of the length and location of each kind of fence, giving the average number, kind and spacing of posts per unit, number and kind of wires, size of plank where used, character of bracing, etc. The number and type of all gates shall be noted. In the absence of fence charts sketches shall be made by the recorder, using conventional signs if desired, for different kinds of fencing.

The location and kind of all cattle guards shall be noted, whether surface or pits, and if surface the kind of material and name of guard or type of construction.

Account 14, *Snow and Sand Fences and Snowsheds.*—The character and extent of all snow and sand fences shall be noted. Where special types of fences are constructed for the purpose of protecting the roadway against snow and sand, although located on the right-of-way line and taking the place of the usual right-of-way fence, they shall be listed in the class above named.

Snowsheds shall be inventoried by the bridge department.

CROSSINGS AND SIGNS

Account 15, *Crossings and Signs.*—The roadway party shall generally inventory all property classified under this account except bridges, piers, abutments, retaining walls, signals and alarm bells. Only general location notes of over-grade or undergrade structures shall be made. Where crossings were built at the expense of the carrier the approaches shall be cross-sectioned and notes taken to determine the amount of grading. Where carriers did not pay for approaches, this fact shall be noted and no cross-sectioning shall be done. Such reliable information as can be secured related to the apportionment of cost and maintenance of public crossings jointly constructed or owned by the carrier and State, or municipality, shall be obtained and recorded, with the source of information noted.

The inventory shall include crossing gates, planking, paving, curbing, etc., also guardhouses and towers at crossings. The notes shall show the type of construction and method of operation of all crossing gates, and also the length of arms, number of posts, etc. Notes shall also show the type of construction and size of flag houses, and sketches shall be made where necessary. General notes only shall be made of the location and kind of signal and alarm bells.

All signs on the right of way of carriers shall be noted, with standards or notes to show variations where found.

OTHER ACCOUNTS

Accounts 16 *and* 17.—The roadway party shall make general location and descriptive notes of station and office buildings. All buildings at railway stations shall be inventoried in detail for the building department. The roadway party, however, shall, unless otherwise instructed, inventory all minor buildings between railway stations. Notes and sketches shall be made of such water, gas, fuel and drainage systems as may be indicated by hydrants, valves, etc., on the ground, and from information obtained from employees or other reliable sources.

The same instructions shall apply to roadway buildings.

Accounts 18 *to* 25.—Where practicable the roadway party shall locate by stations and pluses all water stations, fuel stations, shops and engine houses, grain elevators, storage warehouses, wharves and docks, coal and oil works, and gas producing plants, and shall briefly describe them so that they may be properly identified. Generally the detailed inventorying of such property will be assigned to the bridge or building department.

Account 26, *Telegraph and Telephone Lines.*—Where the carrier is the sole owner of telegraph and telephone lines and the property is of simple construction, the roadway party may inventory same.

Accounts 27 *to* 34.—The roadway party shall locate by stations and pluses signal towers, masts and other signal apparatus; power dams, canals and pipe lines; power plant buildings; power substation buildings; power transmission systems; power distribution systems; power line poles and fixtures, and underground conduits, and shall give such general descriptions as are necessary for identification. The inventory of these properties shall be assigned to other departments.

Account 35, *Miscellaneous Structures.*—The roadway party shall note and make sketches in detail and report character and dimensions of property under this account except such as would be cared for by another department. In any case, however, the roadway party shall make such general notes and statements as to the extent, character and dimensions of structures as will enable their identification and be a general check on the work of other parties.

Account 36, *Paving.*—Notes shall be made separately for paving as follows: Paving about tracks in public highways which was paid for by the carrier and is chargeable to Account 36, and other paving which is chargeable to property to which it is appurtenant. Notes shall show location, character, specifications and dimensions of paving.

THE FLOATING LOCK-ENTRANCE CAISSON built for use in the Panama Canal, and described in the Engineering Record of Jan. 3, page 30, arrived at Balboa Oct. 29. It was towed from San Francisco in forty-three days.

Details of Main Span of Detroit-Superior Bridge at Cleveland

Crown and Skewback Hinge Joints; Floorbeam Connections; Floor Expansion Joint; Lower-Chord Construction; Typical Truss Panel Points

AMONG the special details of the 591-ft. through-truss, three-hinged arch span of the Detroit-Superior bridge over the Cuyahoga River at Cleveland, whose main features were described in the Engineering Record of Nov. 28, page 591, are the connections of the main members, the hinge joints, the attachment of the floorbeams to the trusses at the ends of the span, and the provision for longitudinal movement at expansion joints in the upper and lower decks. The members are of the heavy riveted construction commonly used in railroad work, and in general conform to standard design and practice.

HINGE JOINTS

The spandrel-braced trusses have riveted connections at panel points where the straight sections of top and bottom chords are spliced. All of these connections are rigid except at the ends and centers of the lower chords, where skewback and crown hinges are inserted. At the crown hinge the adjacent ends of the lower-chord sections L11-12 are beveled to give a wide clearance at the top and bottom flanges and allow for the temperature rise and fall, and each half-truss has a separate vertical post L12-U12 and separate top-chord and bottom-chord transverse struts making double members at this point. The spandrel-braced trusses meet on a 12-in. crown pin from which a short steel forging is suspended with a 6½-in. lower pin at right angles to the crown pin. From the 6½-in. pin long vertical eyebars are suspended in the planes of the trusses and support the upper and lower decks. The decks at all points from 5 to 12 on each truss are similarly supported.

The lower end of each bottom chord takes a half-hole and jaw plate bearing on a 16-in. horizontal skewback hinge pin seated in the continuous bearing, which is 40½ in. long, of the multiple-web cast-steel pedestal. The principal face of the pedestal base is about 8½ ft. square and is in a plane normal to the abutment reaction, where it rests on a group of inclined grillage beams embedded in the concrete and anchored by adjustable rods to a double tier of horizontal grillage beams framed together and supporting on one side the narrow horizontal face of the pedestal base. The pedestal and grillage are proportioned for a reaction of which the total vertical component of 4,587,000 lb. is made up of 2,909,000 lb. dead load, 1,478,000 lb. live load and 200,000 lb. impact. The corresponding horizontal component of 4,570,000 lb. is composed of 2,849,000 lb. dead load, 1,516,000 lb. live load and 205,000 lb. impact. Each pedestal casting weighs about 35,000 lb.

FLOORBEAM CONNECTIONS

Between panel points 5-5 both upper and lower decks lie wholly below the bottom chords and are suspended from the latter by vertical eyebars as already stated, and as shown in the general cross-section published in the previous article. At panel points L5 the upper deck intersects the lower chords and its floorbeams are pin-connected to the main truss vertical posts, which are continuous beyond the lower chords to the lower-deck floorbeams. The upper-deck floorbeams at these points are single-web plate girders passing between the built channels composing the vertical posts and extending beyond them to provide cantilevers for the exterior sidewalks.

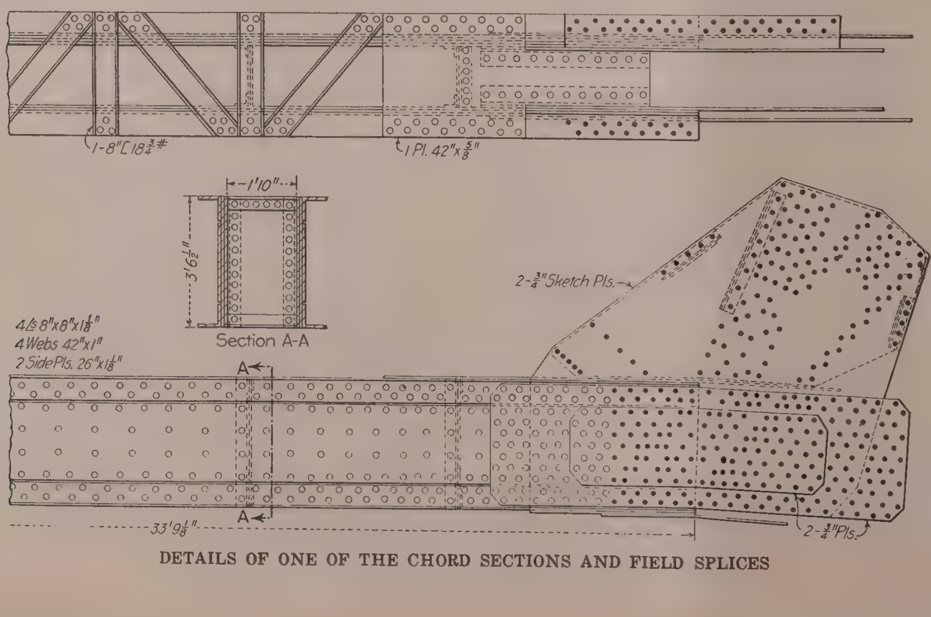
At panel point 4 the upper deck intersects the vertical post intermediate between the top and bottom chords and is pin-connected to it. At panel points 0, 1, 2 and 3 both upper-deck and lower-deck floorbeams are connected to the vertical posts of the trusses between the top and bottom chords, and are field-riveted to them with hitch-angle and gusset-plate connections as shown.

CHORD DETAILS AND CONNECTIONS

Both top and bottom chords change direction at each panel point. The chord sections are planed at their ends and abut against each other, and the chords are spliced with plates on the webs and flanges for from 75 to 100 per cent of their full value. All gusset plates at panel points are ¾ in. thick and form part of the splice. The general details are similar to the ordinary heavy riveted truss construction. U10-L10 illustrates the typical panel-point construction.

The bottom chord, which is the principal arch member, has a uniform depth of 42½ in. and is made up of two built channels. Each section of the chord has three vertical transverse diaphragms made of four 4 x 4-in. ½-in. angles and a ½-in. web plate. The maximum computed stresses vary from 4,534,000 lb. at the crown to 6,272,000 lb. at the end, where the required cross-sectional area of 293 sq. in. is provided by four 8 x 8 x 1⅛-in. flange angles, four 42 x 1-in. and two 26 x 1⅛-in. web plates. These sections are the heaviest members in the span and weigh 26.4 tons each.

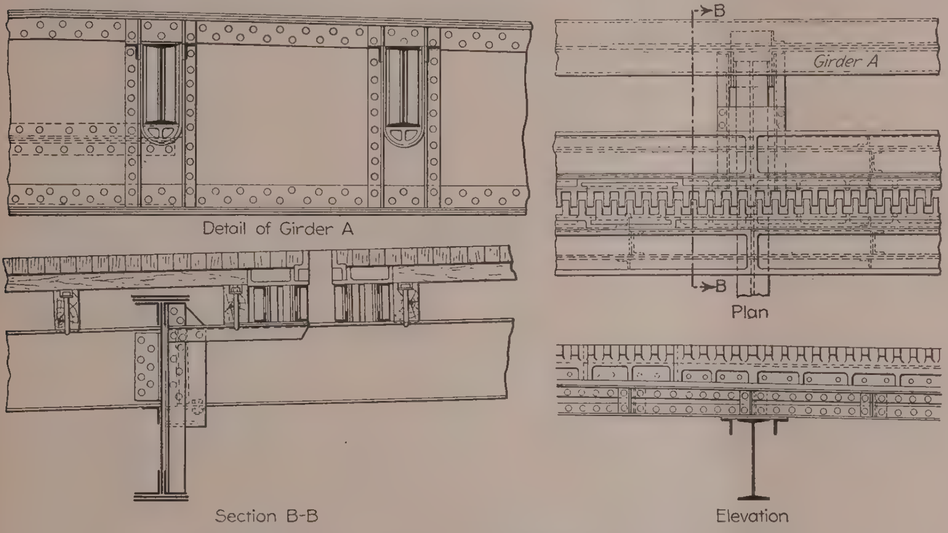
The top chords, which are 27½ in. deep, are all made of two built channels with 6 x 6-in. flange angles, latticed with 7-in. 14¾-lb. channels. The maximum stresses vary from 0 at the crown to 2,077,000 lb. in section U6-U7, which has a cross-sectional area of 100.2 gross sq. in. and 84.7 net



DETAILS OF ONE OF THE CHORD SECTIONS AND FIELD SPLICES sq. in., and is composed of four 6 x 6 x ¾-in. flange angles, two 27 x 13/16-in. web plates and two 15 x ¾-in. web plates. All truss members are of 3.25-per cent nickel steel except latticing stay plates and rivets, which are of carbon steel.

FLOOR EXPANSION

Longitudinal expansion and contraction due to temperature movements in the upper deck are provided for at panel points L5, where the floor intersects the lower chords, by means of fixed and sliding sectional cast-steel aprons. These are bolted to transverse beams seated on the top flanges of the stringers, and each has a set of teeth and spaces registering with corresponding spaces and teeth in the other apron. The teeth are proportioned so that they will never entirely pass each other but will always overlap, leaving at their ends short rectangular openings which increase and diminish with temperature movements.



FIXED AND EXPANSION ENDS OF STRINGERS AND FLOOR JOINT

The sliding stringers are seated on convex castings which fit in the loops of vertical U-plates riveted to web stiffener angles on the floorbeams to form pockets receiving the ends of the stringers.

The bridge, as stated in the previous article, was designed under the direction of F. R. Lander, county engineer, and A. M. Felgate, bridge engineer, who have since been succeeded by W. A. Stinchcomb and A. W. Zesiger, county engineer and bridge engineer respectively. J. A. Joyce, assistant engineer, is in charge of the steelwork. The contractors are the O'Rourke Engineering Construction Company, of New York City, for the main piers, and the King Bridge Company, of Cleveland, for the steelwork.

FATAL RAILWAY ACCIDENTS in Cook County, Illinois, were considerably reduced this year owing to the "safety-first" crusade among railway employees, according to the report of Peter M. Hoffman, coroner of Chicago. According to the coroner's figures, the number of fatal accidents on Chicago street cars has been cut from 209 in 1913 to 141 in 1914. This is a decrease of almost one-third, in the face of a big increase in the number of passengers. The tables show that out of 253 persons accidentally killed on railways and railway highways during the eleven months from Dec. 1, 1913, but twelve were passengers and only nineteen were employees.

Maintaining Macadam Streets in Kansas City

Experience with Pure Asphaltic Oils and Continuous Maintenance Contracts—Life of Pavement Was Doubled by Small Patch Work

By CLARK R. MANDIGO
Assistant City Engineer, Kansas City, Mo.

THE rapid development of the Country Club district, a high class residence addition in Kansas City, Mo., the deterioration of the older water-bound pavement and means for the proper care of the newer bituminous penetration pavement, all of which is macadam totaling over 25 mi. in length, necessitated a flexible method of maintenance. Several of the streets are thoroughfares to large districts beyond and connect with country roads outside the city. In addition a vast amount of building, sewer and paving construction work has been going on in and outside the district. Many of these thoroughfares, therefore, have more than the average amount of traffic for city residence streets.

Contracts were let early in 1911 under a continuous maintenance proposition. An accurate account is kept of the work done and tax bills issued against the abutting property at the end of each 12 months' period covering the cost of the work done in that time. The contracts run for 3 years, at the end of which time they may be re-advertised and a new contract entered into. The same principles apply where the city does the work, except that no unit prices are given, the actual cost of the work being assessed against the property each 12 months during the 3-year period. In all, fifty-seven contracts have been in force.

The average prices per square yard bid were: For holes where the continuous portion repaired in each patch was less than 2 sq. yd., $1.50; for more than 2 but less than 25 sq. yd., $1; more than 25 sq. yd., 75 cents; for rolling the entire surface of the pavement ½ cent and for oiling the entire surface, 6 cents per square yard.

Specifications relating to repairing stipulate that the old material shall be removed to provide for at least 3 in. of new broken stone between ½ and 2 in. in size. After rolling the new material, tar or asphaltic cement to the amount of at least 1½ gal. per square yard is required as a binder. The surface must be covered with clean grit and finally compacted by rolling. Where the old water-bound macadam had become somewhat loosened it is first cleaned with hand brooms and then thoroughly rolled preparatory to oiling.

The oil specified is a pure asphaltic oil having a specific gravity of 10 to 14 deg. Baumé. It shall contain not over 1 per cent on the paraffin scale and not over 10 per cent of fixed carbon. It must be soluble to at least 99 per cent in carbon disulphide, and the bitumen soluble in carbon disulphide, must be soluble in carbon tetrachloride to the extent of 98½ per cent. Future specifications will require not more than 4 per cent loss on being maintained at 165 deg. C. for 5 hours. The asphaltic oil is applied at a temperature of over 250 deg. Fahr. from pressure wagons and broomed in a uniform coating over the surface. A lay of stone chips passing a ⅜-in. mesh screen and from which all dust has been removed is then rolled in.

SUPPLEMENTARY SPECIFICATION

After some experimenting a supplementary specification was drawn to provide for the repairing of slight depressions and the breaks in the asphalt oil carpet. It provides for "surface patching" at the rate of 20 cents per square yard done in the following manner. The depression is swept clean of dirt and dust but the surface is not loosened in any manner. It is then mopped with asphaltic cement and, if less than ½ in. deep, gritted and rolled. Where the depression is deeper two layers of grit and cement may be applied, or a layer of binder rock is used in the deeper portion, which is then coated with more asphalt and gritted. The patches are feather-edged with the grit, the first coating of asphalt being applied slightly farther than the depression extends. These patches adhere to the pavement and under traffic soon have the appearance of the surrounding macadam.

On the first oiling of a pavement on the rock surface about ½ gal. per square yard is required. It is essential that all cake, loose material and dust be removed, and on some streets it was necessary to loosen the old petroleum oil cake with square pointed shovels. It is sometimes impossible to sweep all the dust off, and in dry weather the pavement is lightly sprinkled before oiling. The water collects the fine particles of dust in little globules leaving the bare surface for the adhesion of the oil. When once applied in this manner the pavement can be oiled again at some future time by sweeping clean. The second and following applications are put on as thin as it is possible to apply the oil evenly. With a hot oil, a pressure tank and the pavement dry and warm, less than ¼ gal. per square yard can be applied satisfactorily.

TOUCHING UP PATCHES BY HAND

The asphaltic wearing carpet being thin the first signs of its failure are small patches of the macadam appearing on the surface toward the center of the roadway. These spots can be touched up once a season with a light application of asphaltic oil applied by hand and the patch covered with stone chips, thus doubling the life of the oiled surface. Traffic soon compacts and irons these patches out, although it is considered better practice to roll the grit into the surface.

When maintenance work was started at least 75 per cent of these streets were in bad condition. A great deal of the old macadam has been rebuilt, long stretches resurfaced and the whole 25 mi. of macadam brought to a high standard of perfection. To do this work for the 202,764 sq. yd. of macadam which has been under maintenance for 3 years, cost $54,175,28, or 8.9 cents per square yard per year. This cost included making repairs, where each patch was over 25 sq. yd. in area, to the amount of 32,800 sq. yd. at 75 cents per square yard, or nearly one-half the total cost of repairs, showing the bad original condition of the streets. Included in the above total is 23,252 sq. yd. of bituminous macadam which cost 6¼ cents per square yard per year. Not included in the above total is 12,842 sq. yd. of asphalt macadam laid by the penetration method, in fair condition to begin with. It has been under maintenance for 2 years and has cost 4.4 cents per square yard per year. As the oiling and repairing will be very light during the third year, the 3-year average should not exceed 3.5 cents, with an annual charge thereafter of about 3.5 cents per square yard per year.

Cost Higher But Life Longer

While the cost probably has been higher than usual, the results obtained, in the opinion of the engineers in the city engineer's office, have been very much above the average. At first experiments were tried with all grades and classes of oil from a light petroleum oil to a heavy asphaltic cement. As a result of these experiments the specification given above for road oil was determined upon. In Kansas City the cheapest high grade asphaltic oil is shipped from the Bakersfield district in California. In tank cars, f. o. b. Kansas City, it costs about 7 cents per gallon, about three times the price of residuum oil from the petroleum fields of Oklahoma. The cost applied, including labor and grit, is about 100 per cent greater, while its actual value to the road is considered to be not less than four times the value of the light oil. The asphaltic oil used is very adhesive and has a great deal of "life." Under traffic, a short time after it is placed, it assumes the appearance of an asphaltic pavement, clean, hard and smooth. Being dense and waterproof every rain washes it clean and it can be swept by rotary brooms like sheet asphalt. Under traffic in hot weather the calks of horse shoes will dent it, but wagon wheels iron it out. It does not scale off when applied to a clean surface, and in winter it is hard but it does not become brittle. For example, one street is near a quarry, the entire product of which, amounting to 100 cu. yd. per day of an average for 10 months each year, is handled over this street in 2 cu. yd. wagons, in addition to the usual vehicular traffic. The grade on the street is 4½ per cent. This pavement was oiled with California oil over 18 months ago and has had no attention since. The surface is now in perfect condition, the engineers state, in fact heavy traffic has improved and compacted the surface on all the streets. Another street was oiled in the fall and too much oil, about ½ gal. per square yard, was used. It bled enough at the beginning of the following summer to require gritting twice but was in perfect condition a year later.

These pavements have offered good opportunity for study, as they represent wide differences in methods of original construction. Experiments have been made of various methods of maintenance and cost records have been available for all the work.

Conclusions

The following conclusions are drawn from this experience:

When the qualities desirable in a residence street pavement are considered, ultimate economy, ease of repairs, cleanliness, smoothness and noiselessness, a pure asphaltic oil of 10 to 14 deg. Baumé specific gravity is the best material for the maintenance of a macadam pavement.

The asphaltic oil, while more expensive in first cost, is cheaper in the long run because it takes all the wear off the rock in the macadam surface by preventing holes from developing. It can be replaced in the worn portions without recoating the entire surface. It lasts three to four times as long as a petroleum residuum oil and applications, subsequent to the first, require from one-half to two-thirds of the material used in the first application.

The continuous maintenance method is the only satisfactory one for macadam pavements on urban streets.

In no case should a macadam pavement be built without a bituminous filler as a binder for the top course of rock.

Where the bituminous macadam is to be maintained continuously with asphaltic oil as described, it can be built originally by the penetration method with safety. The top course of rock, laid on a sealed base course of sufficient thickness and compactness to sustain the loads coming upon it, can well be reduced to 2 in. in thickness, and the amount of asphaltic cement used as a binder may be reduced to 1 gal. per square yard. If tar filler is used not less than 1½ gal. per square yard will be required.

The asphaltic oil wearing carpet should be placed on a new pavement of this kind after it has had some travel, but before it begins to show the least sign of wear, that is, usually within the first 6 months after completion.

Stone Production in the United States

The total value of the stone produced in the United States in 1913 was $83,732,995, as compared with $78,193,220 in 1912, an increase of $5,539,775, or 7.08 per cent, according to a report by Ernest F. Burchard printed in "Mineral Resources, 1913—Part 2." The year surpassed all previous years in the value of its stone output, the value of granite, trap rock, sandstone, marble and limestone increasing 8.17, 22.88, 2.02, 1.08, and 5.49 per cent respectively over the value for 1912.

The accompanying table shows the value of the different kinds of stone produced in the United States from 1901 to 1913, inclusive:

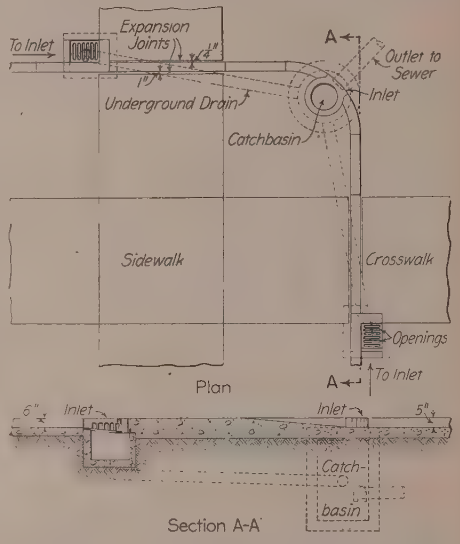
Value of the Different Kinds of Stone Produced in the United States, 1901-1913

Year	Granite	Trap rock	Sandstone*	Marble	Limestone	Total
1901	$14,266,104	$1,710,857	$8,138,680	$4,965,699	$18,202,843	$47,284,183
1902	16,083,475	2,181,157	10,594,483	5,044,182	20,895,385	54,798,682
1903	15,703,793	2,732,294	11,262,259	5,362,686	22,372,109	57,433,141
1904	17,191,479	2,823,546	10,273,891	6,297,835	22,178,964	58,765,715
1905	17,563,139	3,074,554	10,006,774	7,129,071	26,025,210	63,798,748
1906	18,562,806	3,736,571	9,169,337	7,582,938	27,327,142	66,378,794
1907	18,064,708	4,594,103	8,871,678	7,837,685	31,737,631	71,105,805
1908	18,420,080	4,282,406	7,594,091	7,733,920	27,682,002	65,712,499
1909	19,581,597	5,133,842	8,010,454	6,548,905	32,070,401	71,345,199
1910	20,541,967	6,452,141	7,930,019	6,992,779	34,603,678	76,520,584
1911	21,194,228	6,739,141	7,730,868	7,546,718	33,897,612	77,108,567
1912	19,223,302	7,560,049	6,893,611	7,786,458	36,729,800	78,193,220
1913	20,793,800	9,289,809	7,033,067	7,870,890	38,745,429	83,732,995
Percentage of increase (+) or decrease (—) for 1913	+8.17	+22.88	+2.02	+1.08	+5.49	+7.08
Percentage of total	24.83	11.10	8.40	9.40	46.27	100.00

*Includes bluestone.

Inlets at Street Corners

To obviate a continuation of gutters along curbs at crosswalks and give a level passageway for pedestrians from sidewalk to crosswalk, the Information Bureau of the Universal Portland Cement Company has recently developed the plan shown in the drawing herewith. The inlets are specially designed with three openings, a regular cover grating and two vertical gratings, one along the curb and one along the crosswalk. By this method the water is conveyed under the pavement to the catch basin located at the corner.



DETAILS OF SUGGESTED CORNER LAYOUT

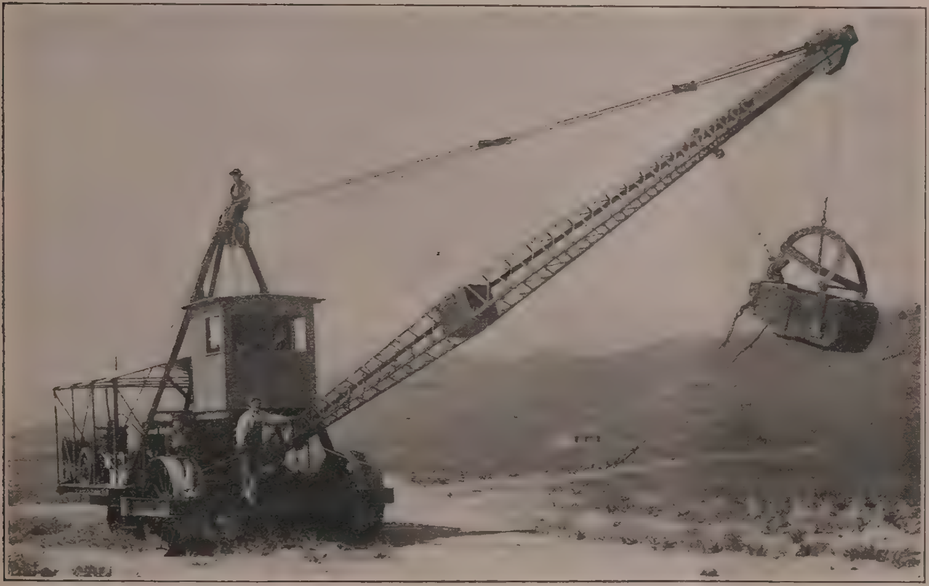
Specifications for Spokes, mallets and other articles using hickory excluded for many years the red hickory, it being supposed that this variety was not as good as the white. To determine the truth of the idea the U. S. Forest Products Laboratory at Madison, Wis., conducted a large number of tests and found that the discrimination against red hickory was unwarranted, and that if one had wood which was as dense with the red as it was with the white there was little difference in the quality of spokes. The matter was taken up with the Isthmian Canal Commission and the latter changed its specifications for pick handles, thus decreasing materially the waste that formerly existed in discarding red hickory.

New Type of Traveling Excavator for Ditches

Details of Drag Bucket Plant Which Lowered Costs from $1 to 12 Cents per Cubic Yard

By W. W. PATCH
Consulting Engineer, San Francisco

DURING the past ten years the rapid increase in the area of irrigated lands in the Western states has brought to the attention of land owners and irrigators the fact that, following the installation of an irrigation system, increasing demand is made for drains to carry off the surplus water, which has its origin largely in the overuse of irrigation water.



DRAG-LINE EXCAVATOR AT STOCKTON MOVING CROSS COUNTRY

Owing to the impracticability of building a complete drainage system at the time this distribution laterals are constructed, it happens that much of the drainage work must be done after the ground has become so saturated with moisture as to make work with horses, or by ordinary methods of excavating, almost impossible. There are also frequent cases where an existing drainage ditch has become filled with silt to an extent requiring reexcavating or deepening to a depth of several feet. This class of excavation when done by men and teams under the wet conditions generally prevailing has cost about $1 per cubic yard. The majority of the drainage ditches on any irrigation project require a limited carrying capacity, and hence are constructed of the minimum cross-section which will stand up reasonably well when built to the necessary depth. Such ditches when first built make from 2 to 5 cu. yd. of excavation per linear foot, but when being cleaned out may average only 1 to 1½ cu. yd. per foot run.

REQUIREMENTS FOR MACHINE

In order to meet these conditions an excavating machine must be able to remove expeditiously and cheaply the softest kind of semi-fluid silt from the bottom of a ditch which is carrying running water, and must also be capable of excavating indurated materials from the bottom of such ditches. While at work it must move along the bank of the ditch under its own power every few minutes without delaying operations, and it must be able to travel from place to place along ordinary country roads and across bridges, at the rate of several miles per day, when moving from one job to the next. It must have a minimum of weight consistent with adequate strength, and the weight must be so distributed that the machine can readily be carried on planking when working on wet or swampy ground.

Several years ago the writer was in the market for such an excavating machine and for a long time failed to find one which fulfilled all of the foregoing conditions. A self-propelled clam-shell excavator was then at work removing silt from the ditches of the Imperial Valley irrigation project in southern California and northern Mexico. This machine was doing very satisfactory work at that place, but it was not adapted to the work of removing indurated materials. The writer then suggested a number of modifications in the design of the Imperial Valley machine, which were made; chief among them was the addition of a drag-line bucket. The improved machine was manufactured by the Stockton Iron Works, of Stockton, Cal., and during the two seasons it was in use on work under the writer's direction it has been very successful.

The machine is shown in the accompanying photograph. It is equipped with both a clam-shell and a drag-line bucket, and weighs with either bucket about 20 tons. Its power is derived from a 20-h.p. heavy-duty upright gasolene engine, operated with distillate, and when traveling along the road in high gear the machine makes abut ¾ mi. per hour. Under these conditions the jack arms are removed and are carried upon the deck, thus giving a maximum width of 15 ft. 6 in. At the intersections of 60 ft. roads turns of 90 deg. can be made readily, and as the distance between the two axles is over 19 ft. there are seldom any highway stringer bridges which are subjected to a span load exceeding about 12 tons. The form of bucket bail is similar to that used in the Page drag scraper.

DRAG-LINE BUCKET

As this machine has been used almost exclusively in deepening by several feet ditches already in use, and as the bottoms of the ditches for about half their lengths encountered material which required blasting, it was found necessary to use the drag-line bucket almost from the start, to the practical exclusion of the clam-shell. With the ample engine power available the drag bucket can be heaped to carry in excess of ½ cu. yd. Hence, unless the material was almost fluid, it is probable that the output of the machine would be greater with the drag bucket than with the clam-shell. Several minor improvements in the design have been made as a result of experience in operating it, such as the addition of a "fair leader" near the foot of the boom, and the addition of a false shell on the hoisting drum to increase the hoisting speed when using the drag-scraper. Change from one type of bucket to the other can be made in about an hour by removing this shell and reeving another cable in place of the drag cable. The sheaves subject to the most wear have been made of steel, and manganese steel fittings have been applied to the drag-bucket wherever practicable.

COST AND CREW

When operating under the most favorable conditions this machine, with a crew of four men, has excavated 400 cu. yd. in a day of 8 hr. While for a period of seven months the average performance has been at the rate of 40 cu. yd. per hour, even when time lost on account of repairs and moving from place to place is included. If blasting is required, or if the ground is so soft as to require planking beneath the wheels of the machine, then the crew is increased to a total of six men. A detailed statement of the cost of operating the machine for a continuous period of seven months during its second season is given in the table. This statement contains a liberal allowance for depreciation of the plant among the other items.

COSTS OF OPERATING TRAVELING EXCAVATOR IN SOUTHERN OREGON FOR SEVEN MONTHS, APRIL TO OCTOBER, 1913.

Item	Cost	Cost per cu. yd.
Labor, men	$2,670.38	$0.0476
Labor, horses	499.30	.0089
Explosives	324.97	.0058
Fuel, gasoline	290.03	.0052
Supplies (grease, oil, lumber, etc.)	524.75	.0094
Depreciation, machine	1,194.00	.0213
General expenses	712.15	.0127
Miscellaneous	99.00	.0018
Repairs	340.65	.0061
Total	$6,655.23	$0.1188

The work comprised deepening an old ditch which carried drainage water constantly. The old section was about 2 ft. deep, 4 ft. wide, and had 1.5 to 1 side slopes. The new section was 5 ft. deep, 5 ft. wide at the bottom and had 1.5 to 1 side slopes. The ditch was about 4 mi. long, and for approximately one-half of its length the bottom 2 ft. was in indurated materials which required blasting before it could be excavated.

The crew comprised from 4 to 6 men and 2 horses at the following wages: Machine operator, $130 per month; gas-engine man, $80 per month; powder-man, $3 per day; 2 laborers, each $2.48 per day; 2 horses, each $1.25 per day. A day's work comprised 8 hr. on the job. The total material moved was 56,017 cu. yd. or approximately 40 cu. yd. per hour.

WORKHOUSE PRISONERS at Dayton, Ohio, are used on municipal improvements, parks, cleaning and repairing streets.

Publicity for Engineering Work

THE three articles following relate to a subject now receiving much attention from engineers. Mr. Cooke presents the advantages of educating the public to a knowledge of the importance and necessity of municipal engineering works. Mr. Drayer advocates organized publicity work for engineering societies and tells what the Cleveland society has done, while Mr. Ankeney gives details of the method of handling the publicity on a project affecting a wide area.

Special Phases of Municipal Engineering

Difficulty in Securing Consulting Engineers and Value of Publicity Emphasized by Philadelphia's Director of Public Works

WIDER use of engineers in public service and the employment of well-recognized means of securing publicity for engineering work of a public nature were two points receiving special emphasis in a paper entitled "Some Factors in Municipal Engineering," read before the American Society of Mechanical Engineers in New York last week by Morris L. Cooke, director of the Department of Public Works, Philadelphia. In addition to these points Mr. Cooke discussed the need for expert advice in municipal work; the unfortunate restriction upon engineers in making expenditures, giving them no contingent fund for emergencies and research work; the absence of a financial program based on a consideration of the needs of the city over a considerable period; the impossibility of securing competent department heads through the generally accepted Civil-Service rules, and, finally, the advisability of establishing a municipal reference library, in which might be deposited copies of engineering reports that do not find their way into print, as well as copies of all printed documents of value to the municipal engineer.

The extracts from Mr. Cooke's paper which follow relate, however, only to the availability of engineers for public service and the value of publicity:

Role of the Engineer

The role which the engineer is to play in the development of our municipalities will depend primarily upon the attitude taken by the profession as a whole toward what appears to be a wonderful present opportunity and also upon the ability with which the work of the engineer is brought to the attention of the public. There is no real reason why municipal engineering should not be made to comprise most municipal undertakings.

The test by which the role of the engineer is to be determined will be the development in our profession of a genuine spirit of public service. The community is apparently ready to accord the engineer a leading, perhaps a controlling part, if the engineer will consider that in every decision and act there shall be the clearest possible recognition of the public interest.

There are certain kinds of engineering in which financial and almost all other kinds of preferment depends on an attitude of mind which, while not necessarily anti-social does not provide sufficient opportunity for entertaining a virile public point of view. As a representative of public, rather than private interest, it is my duty in choosing the advisers of the city which I have the honor of serving to satisfy myself not only as to the ability of those we employ, but also as to their disinterested—yes, their public point of view.

Lack of Qualified Men

Judged by this standard, there are in certain fields of engineering almost no engineers who are at present available for the service of the public and who at the same time have had sufficient experience for large undertakings. In the past few years we have had unusual opportunities for seeing at close range the professional attitude of those equipped with the technical knowledge required in advisers to cities on utility matters. It has been practically impossible to secure the services of those with reputations already made in the electrical field. Some of our experiences could be considered on the whole rather amusing were it not for the fact that we are left under the obvious conclusion that for the average city official to get good advice on these matters, is well nigh impossible. What is more objectionable is that this condition is one quite generally recognized as true by city officials. We hear a good deal of complaint on the part of engineers that as a profession we are not chosen more frequently to serve on public service commissions and for similiar technical work. Perhaps in our experience may be found at least part of the reason for this condition. Of course when a city wants advice on a subject such as this the matter is usually one of considerable importance, often involving large sums of money, and in reaching conclusions the city official should not be dependent for advice on junior members of the profession.

The same tendency is to be noted in other branches of our profession. An eminent authority on concrete, who is in intimate touch with the men who are practising in this line, was recently asked for the name of an engineer who was not in any way affiliated with the large manufacturers of this material and after considerable study was able to think of only one man. There is nothing necessarily improper in this situation—it may simply mean that all the competent men in this line receive retainers from manufacturers. Some months ago I wanted to retain an engineer fully posted on the details of a certain sub-division of railroad operation. It was extremely difficult to find a man without recognized affiliations which would preclude his retention. Again I am informed that there are no asphalt experts who do not receive retainers from the manufacturers. It is a condition which should be provocative of thought by engineers.

I would not have you think that I do not fully appreciate that our present situation is the natural outgrowth of the fact that all of the foremost engineers have become prominent through the service of private interests. Public employers up to the present have been almost a negligible factor in furnishing opportunity for employment or for the making of a reputation. It is perfectly natural, and it is in accord with former ideals that engineers should feel their first duty to be to these private employers. But in this time of broader and deeper social consciousness it seems to me that this standard must change.

Magnitude of Opportunity

In inviting the attention of our profession to the municipal field, we are apparently opening the door of opportunity to tens of millions of dollars worth of work which is not now either considered engineering nor carried on by engineers. The municipal field is almost virgin soil so far as engineering is concerned. As recently as ten years ago the problem of snow removal which is being discussed as a part of this day's program, was so absolutely in the hands of thumb rule, and in many instances even of inexperienced men, that it is probably true that in no city in this country was it being attacked either by engineering methods or by engineers. Yet it will not be denied that on work of this kind, in which one city spent nearly $3,000,000 in six weeks last year, there is in reality an engineering problem of considerable magnitude.

If this municipal field is to be one in which engineers of ability, sincerity of purpose and high ideals are to find a permanent and satisfactory outlet for their energies, our profession acting as a profession will be one of the main agencies bringing about certain fundamental changes in the attitude of the public. In the minds of too many engineers, participating collectively in matters pertaining to municipal engineering means "getting into politics." Architectural work being a part of the business of the Department of Public Works in Philadelphia, we have had the co-operation of the American Institute of Architects and of its Philadelphia chapter from the beginning. We have made many demands on them and in every case have met with generous and enthusiastic response. This assistance has been entirely apart from the help rendered us by individual architects. We have had the constant, indefatigable and valuable support of the secretary of the American Society of Mechanical Engineers in our efforts to maintain the highest professional standards in the work of the department. But engineering bodies as such have given us no assistance and, so far as I know, have taken no part in the discussion of federal, state and municipal engineering, except in the matter of conservation, which for some reason is considered as innocuous from an engineering standpoint as a prayer-meeting.

Publicity

I am not one of those who feel that all our short-comings are "the fault of the people." I would rather assume my share of the responsibility for conditions as they are and then join with my professional associates and the community at large in bettering them. If we engineers are to have any prominent part in this there are fundamental changes which we shall have to make in our own equipment for the work. In the first place, we have to get rid of the now old-fashioned idea that advertising is a crime. I admit that as a part of my work as a public official I put in a great deal of thought on what may be quite properly called advertising. By that I mean that I pay less attention in my reports to dignity of form and diction than to making them sufficiently interesting to be read. It is only as we engineers who are public officials learn to make the public, sometimes against its will, understand our work, that we are to get that degree of popular support for it which will make it possible for it to be done in an efficient manner.

In my opinion it is going to become more and more a necessity, not only in public but in private work, for engineers to be able to popularize what they are doing. It is true to-day that a man who wants to do really good and efficient work can do so only after an aroused public opinion. You cannot drive people in a democracy. So I admit that in offering employment to an engineer, other things being equal, I want what might be called a good advertiser. You can secure appropriations for work more easily when it is well advertised. The Panama Canal is a good example of this principle. Again, advertising is the best possible check against ill advised expenditures. In building our Byberry and Bensalem service-test roadway we erected sign-boards on each of the 26 sections giving to the layman the exact method of its construction in non-technical language. If the public knows how a street is supposed to be constructed or cleaned, you do not require as many paid inspectors on the job.

Development of Public Opinion

The development of some varieties of municipal engineering is absolutely dependent upon the development of public opinion and must proceed with it. The matter of street cleaning is largely a question of an improved public taste in the matter of street paving. Unless streets are well paved they cannot be well cleaned except at a prohibitive cost. To jump from one degree of cleanliness in this respect to another without a supporting public opinion may be enough to wreck an administration and to set the tide of civic improvement running in the opposite direction.

The newspaper is the great educator in these matters to-day. But we are already using in Philadelphia moving pictures, parades and exhibitions. The possibilities of these and other means of publicity are not yet fully understood.

Again, more effort must be put into humanizing public administration. The engineer shares with those who have had the opportunity for education, the mistaken idea that the man at the top is in a position to tell the man at the bottom what is good for him. The fact that our country was founded and has been perpetuated on the contrary idea has not seemed to affect the situation very much.

Take, for instance, the movement which has led to the formation of large numbers of business men's associations and improvement associations. I have found these associations ready and anxious to hear from men who had definite knowledge on matters of public interest. It should be the attitude of any engineer who wants to play his part in the community to affiliate with one of these organizations and to help to make it an influence.

How One Engineering Society Secured Publicity

Results of the Cleveland Society's Activities and Suggestions for the Extension of the Work Through Other Media

Newspapers and the public are eager to get authentic information on engineering work, and proceeding on this belief the Cleveland Engineering Society has, during the past two years, made notable progress in securing the confidence and co-operation of local dailies. At the annual meeting of the American Society of Mechanical Engineers in New York last week, C. E. Drayer, chairman of the publicity committee of the Cleveland society, described the society's procedure and the results, and offered suggestions for the extension of the work.

His paper, practically in full, follows:

Newspaper Co-operation

Our first step was to get acquainted with the managing editors of the two leading papers in the city. They were told that the society had about 500 members, many of whom are at the head of large undertakings on which the growth and prosperity of the city depend. They were told that the society stood ready to co-operate with them in obtaining such engineering news as would be of interest to the community. We were assured that the newspapers welcomed our assistance, and were advised to have the society try being its own reporter.

It so happened that the outcoming issue of the society's "Journal" contained the report of a special committee on technical education in Cleveland. Naturally, a large number of people in the city were interested in what engineers had to say about their technical schools. Abstracts to make about three-quarters of a column were written, ready to set in type, and were handed to the editors of the two morning papers. They were printed without alteration. A third paper printed its own abstract and an editorial. If the committee had something to say which the public would be benefited in knowing, surely 200,000 papers with authentic information was a better medium than the 1500 copies of the "Journal" read largely by technical men.

Probably the largest service to the community performed by the publicity committee of the Cleveland society was the publishing of fourteen inspirational articles by prominent local engineers on "Engineering as Life Work." The articles appeared on successive Sundays in the magazine section of a local paper. Beneath the title of each was an editor's note stating the purpose of the series and that they were published under the auspices of the society. Among the contributors were two past-presidents of the American Society of Mechanical Engineers and a past-president of the American Railway Engineering Association. The theme of the series was to tell the young man about to choose life work what is before him in the various branches of the engineering profession. Besides appearing in the local paper, most of them were published in the "Scientific American" and the "Case Tech," the student publication of Case School of Applied Science. Some appeared in other periodicals over the country.

Civil Service Examinations

While we might multiply instances like the above where our work was distinctly a service rendered the public, we shall pass to an enumeration of the tangible benefits to the society and to the profession growing out of the publicity work.

A higher standing in the estimation of the people and of those in authority in the affairs of the community is one gain. In Cleveland, the co-operation of the society is usually sought in the solution of questions of public welfare where engineers are qualified to speak.

To cite an instance, the Civil Service Commission early in the present year asked the society to assist it by taking charge of the preparation and marking of papers for engineering positions. The first request was for ten examinations, and the results to both the commission and to the society were very gratifying. The commission secured the service of experts at no cost to the city, but which were worth more than it had available funds to employ. The secretary of the commission told us that the candidates were satisfied with the fairness of the examination. Concerning previous examinations complaints have been made that proper relative weights had not been given to experience and theoretical training. Our publicity committee saw to it that the public learned through the newspapers of the arrangement between the Civil Service Commission and the engineering society. Credit was given where it was due.

Benefits to the Society

When the local society engages in publicity work, a revival in the interest of its members in the activities of the society will be apparent. The indifferent members find they have some pride in their society when its activities, of which they approve, are described in the daily paper. Due largely to the publicity work, there has been a substantial increase in percentage of attendance at the meetings. One estimate was 15 per cent. To stimulate attendance, the committee furnishes the papers advance notices of the meetings, consisting of a picture of the speaker and some 150 words of text telling about him and his subject.

During the last two years some 250 new members have been added to the roll, an increase of over 50 per cent in a society past thirty years old. Of course, it is difficult to say just what percentage of increase in an organization recently very active in all its functions may be credited to publicity work.

Extension of Work

We have enumerated some of the benefits accruing to the profession and to the public from publicity work conducted along a definite plan in one locality. Let us now turn our attention to a statement and suggestion of a solution of the problem in its application to a broader field.

Considerable study should be given to the technical aspect of our problem before active work in a large way is undertaken. We can, however, enumerate the various channels by which information of an engineering nature may be placed before the public. It is also possible to give approximate relative values to them.

Everybody reads. If they read nothing else, they read the newspapers, so it is the most direct way to reach the greatest number. An important point in favor of the newspaper is that it is local and offers an opportunity for the local engineering society to place in its columns engineering news that has an especial appeal to the community. Most people have a friendly attitude toward one of their local papers and are ready to take to heart what they read in its columns, particularly when they know the source is authentic. So the community will learn about its citizens who are engineers and what they are doing to promote its welfare. For these and other reasons, such as frequency of appeal, we are inclined to give newspapers the place of first importance in publicity work for engineers.

The national periodical or magazine has a quality of permanence which the newspaper lacks. Each issue is likely to be before the public for from a week to a month, whereas, at least in our large cities, each issue of the newspaper is being read but part of one day. On the other hand, care must be taken in the selection of magazines for publicity purposes unless the plan is to reach a particular class. If a magazine has an article on a special subject, it is unlikely that any considerable space will be allotted to the same subject during the same year. It has been demonstrated that the first appeal must be reinforced by subsequent ones for the memory to retain a definite impression.

PAMPHLETS AND LECTURES

Pamphlets or monographs possess an important advantage over newspaper and magazine publicity in that their contents do not have to pass a possibly unsympathetic censorship. They can be placed directly and quickly into the hands of those for whom they are intended. While they should have attention-holding power able to compete with the newspapers for the readers' interest, they are free from the competition due to a multiplicity of appeals existing in every magazine and paper. It is probable that effective work could be done by using pamphlets for engineering publicity.

It is doubtful if memory is more retentive and the mind more plastic at any time in life than during the high-school age; also at that time information is eagerly sought for making a choice of life work. Here lies an opportunity to tell the future leaders in all walks of life what it means to be an engineer as well as to warn away those who have been captivated merely by its romantic side.

In every city there are a great many opportunities to talk before clubs of many kinds. We are aware that a good deal is being done in the way of popular lectures on scientific subjects, but more might be done, as a part of our service to the community. Where possible the local engineering society might let it be known that it could by arrangement furnish speakers on certain subjects.

There remain a variety of ways by which information may be placed before the public. For the most part they have not been analyzed, some not even suggested. In this miscellaneous class may be mentioned exhibits and moving pictures. We are inclined to believe that both have possibilities which would be discovered when once the work was undertaken.

Securing Popular Support for a Great Project

Details of Campaign for Correcting Erroneous Opinions Regarding Procedure in Dayton Flood-Prevention Investigations

By S. H. ANKENEY
With Dayton Flood Prevention Committee

PROPER publicity is fast becoming a recognized factor in engineering work. Railroads in particular have displayed a wonderful change in attitude in this regard. Until recent years they shunned printer's ink in every form much as if it were a plague. Today several of the large systems are paying large salaries to publicity managers who not only aid daily newspapers—the common enemy of yore—to secure news items, but also publish numerous varieties of what might be termed "house organs" for want of a better name.

Such enormous undertakings as the Panama Canal and the Catskill Aqueduct found it desirable to publish weekly papers carrying not only reports of the progress of the work, written in readable style, but also the society news of the camps, personals, etc.

NEW USE FOR PUBLICITY

A somewhat different use for publicity has been found in the flood prevention work in the Great Miami Valley. In the great floods which swept Ohio and Indiana late in March, 1913, Dayton suffered enormous damage. Immediately afterward the progressive citizens of Dayton sought some way of safeguarding themselves and their property from a recurrence of the disaster. Evidently it was a technical problem. Engineers must be employed, money would be needed. So an appeal for funds was made while the flood was still fresh in the memory of all, and more than $2,000,000 was raised within two weeks by popular subscription. With this money subscribed and engineers employed, a new difficulty arose. More than 22,000 persons, out of a total population of 125,000, had contributed to the fund. Naturally all the contributors were keenly interested in seeing work commence.

The campaign closed May 25, just two months after the flood. The Morgan Engineering Company, of Memphis, Tenn., which had been retained by the Flood Prevention Committee, had already started field work. The field force was swelled to about fifty men, divided into five parties. One party was assigned to the task of making surveys within the city proper, three other parties traversed the Miami, Stillwater and Mad Rivers, which converge at Dayton. The fifth group, called the hydraulic party, was sent out to make stream-flow measurements on all the rivers. The total drainage area above Dayton is 2500 sq. mi. To cover adequately streams in this territory, run out base lines, record cross-sections, etc., required time.

Not more than two months had elapsed before criticisms were heard. The current opinion seemed to be that dredging the river would be the only solution of the flood problem and the average citizen did not bother himself as to where the dredged materials could be placed or how effective this form of protection really would be, to say nothing about the actual monetary outlay necessary.

Many persons who claimed that they were qualified to judge insisted that the excessive flood height in Dayton was due to obstruction of the channel by five concrete bridges. The removal of these bridges, they said, would prevent future floods. Practically an equal number declared that the control of the floods was beyond human agency—that nothing could be done to prevent another such disaster.

These extremes show the wide divergence of opinion that existed. As a matter of fact, the concrete bridges had practically no effect on the flood height and while the channel may have been somewhat encroached upon, it still has about four times the capacity of the channel immediately above and below the city.

Another view was that the floods had been produced by the Loramie and Lewistown reservoirs, constructed as feeders for the Miami and Erie Canal and situated at the headwaters of the river. As a matter of fact, these reservoirs did not break and they have but two outlet gates, 4 x 6 ft. in dimensions. If anything, the reservoirs lowered the flood height immediately below.

The local newspapers, their appetite for news whetted by the prominence given flood prevention work in the campaign for funds, detailed their best reporters to "follow it up." They did not realize that the work being done was not good newspaper material. Daily calls at the engineers' headquarters, where the monotonous routine of the drafting office prevailed, left them with but one recourse—to write "pipes." Consequently garbled and sensational items found their way into the daily press, badly distorting the real facts and agitating the public mind in a way most undesirable for the flood prevention work. Now and then, when real items of interest were available for the papers, the reporters, through lack of understanding of engineering terms, so changed the information that its effect was even worse than worthless—it was harmful.

This newspaper situation only aided in promoting the general criticism that "something should be done," "the river should be dredged," "we should have protection from floods by next Spring."

DIRECT PUBLICITY WORK

The editors of the various newspapers were invited to a conference at which this condition of affairs was frankly discussed. They said they wanted to help the protection work. A publicity manager or press agent was suggested. It met with approval and the outcome was a campaign of education conducted through the newspapers by a graduate civil engineer who had had previous newspaper experience.

The first thing attempted was an article outlining why it was necessary to make a thorough preliminary survey. The work of the different field forces was written up. Photographs of them at work in the field were used as illustrations. Then followed other articles pointing out the necessity for recording the high-water marks and for determining the amount of the flood flow, the location of bridges and their waterway capacity and the slope of the river channel. Every effort was made to keep the public informed why this and that was being done. Letters of interrogation and of criticism which appeared in the papers were answered.

However, in all cases the articles were made newsy. The editors were not asked to print matter that did not warrant space in their columns. Editorializing was carefully avoided. When it was found necessary to emphasize a point by commenting thereon an interview was arranged and some one of local prominence quoted in this connection.

At this time it was not known whether the surveys would determine that channel improvement, a system of retention reservoirs, or a combination of both would furnish the best solution of the problem. Nevertheless, a series of weekly articles was published, taking up one at a time the various flood protection problems encountered in this country—at Kansas City, Galveston, Pittsburgh, Denver, East St. Louis and on the Colorado River. Another series describing foreign flood prevention works and illustrated with photographs was published simultaneously in a rival paper. This answered the critics, some of whom were engineers, who asserted that reservoirs of this type had never been in operation before.

The effect of these articles will never be fully known. It is confidently believed, however, that they drove home to the public the enormity of the task facing the engineers. If this was actually accomplished, the articles undoubtedly did much to still the unreasoning criticisms.

TELLS WHAT RESERVOIRS ARE

After the engineers' preliminary report had been rendered and a system of retention reservoirs recommended, effort was made to enlighten the public as to the reasons for the recommendations. Because of the familiarity of Dayton citizens with the Lewistown and Loramie Reservoirs, the great majority of people thought that the proposed reservoirs would be at all times full of water.

The ardent nimrods were joyful, but others were apprehensive of the constant danger that would hang over their heads. Consequently it was necessary to repeat again and again that the reservoirs would be made by constructing huge, immovable hills across the valley and that they would not contain water except during periods of unusually excessive rainfall. Emphasis was laid upon the size of the proposed dams so that they would not be confused with the earthen levees which all knew were susceptible to wash-outs during floods.

One of the efforts to educate the people in this connection was the construction of a 9 x 6-ft. papier-maché model of one of the dams. This showed graphically the method proposed for controlling the floods, the great strength of the dams and the general lay-out of the spillway, outlet tunnel and other features of the design. This model was put on exhibition at a prominent street corner. A similar model, made of tin, was actually filled with water and caused to operate under the various conditions for which it was designed. Motion pictures were taken of the model and these gave a very realistic view of a flood in all its stages and the protection accorded the valley below.

POLITICS MIXES IN

Six of the seven reservoirs, it is proposed, are to be built north of the city in districts that suffered the least damage from the flood. As the reservoirs, when full, will overflow approximately 40,000 acres of land and require the removal of the homes of about 400 farmers, ground for opposition was easy to find. This opposition, conceived and fostered, it is believed, by those with political ambitions, rapidly outgrew the bounds of reason. Several speakers took the stump and, by resorting to personalities and abuse, shortly developed a large following of those who did not pause to reason why.

Efforts were made by the Dayton Flood Prevention Committee to stop this unreasoning opposition by giving publicity to its plans and methods. Open meetings were held in town halls and school houses throughout the valley. At these meetings motion pictures and stereopticon slides were used to good advantage.

The talks would generally open with a selected list of flood views showing the terrible devastation wrought by the flood. These would be followed by sketches showing the results of extensive rainfall investigations, which proved that another such flood might at any time be expected, by a bird's-eye view of the entire territory to be included in the flood-protection measures, and by cross-sectional drawings of the proposed dams. These would be compared with cross-sections of the famous Johnstown dam, in order to refute wild statements that the proposed dams would undoubtedly break.

Inflow and outflow curves were used to show the regulating effect the reservoirs would have upon flood flows, and finally two views would be presented, one with a reservoir in its normal state, the valley above the dam in cultivation and flocks pasturing on its broad sides, the other with the reservoir full and the outlet tunnel discharging only at the safe capacity of the river. The motion pictures showed large dredges and other construction machinery at work on some of the Morgan Engineering Company's southern projects. Following the presentation of these views the meetings invariably would be opened to discussion.

ARTIST'S DRAWING OF DAM FOR PROPOSED TAYLORSVILLE RESERVOIR USED FOR LANTERN SLIDE

NEWSPAPER SUPPLEMENT

In addition to this, a four-page supplement, newspaper size, was prepared, giving a full but concise statement of the facts, without comment or argument, in connection with the legal and engineering phases of the work. A discussion of the rainfall investigation was included and statements of several engineers on the efficacy of reservoirs.

This supplement was distributed to more than thirty papers throughout the valley, the date of publication being so selected that it appeared simultaneously in city daily and county weekly papers. The heading of each paper was printed thereon and as many copies furnished free as the paper would use. This supplement gave the Flood Prevention Committee's side of the question to all who were willing to read and reason.

While opposition has not been entirely

stilled by this campaign of education, the belief is held that the thinking class of the various communities, even in opposition territory, favor the engineers' recommendations. Certain it is that the citizens of Dayton understand the problems that confront their committee and are back of the latter almost to a man. Whether this would have been the case had the newspapers continued their unfavorable comments can well be doubted.

One Year's Work of the U. S. Reclamation Service

Statistical and Other Information Bearing Upon Constructional, Administrative and Educational Achievements During 1913-14

THE annual report of the Secretary of the Interior for the fiscal year ended June 30, 1914, just issued, contains a tabulation of the work done during the year by the U. S. Reclamation Service. The work accomplished is itemized as follows:

1. Stored enough water in its various reservoirs to make a lake 50 mi. long, 15 mi. wide and 10 ft. deep.
2. Diverted 4,000,000 acre-feet of water (a stream equal in volume to the Hudson River where the Mohawk enters it) and irrigated 700,000 acres on 16,354 farms, an area equal to that of Rhode Island. These farms provided homes and occupation for 61,253 people and produced crops valued at $15,732,000, or about $25 per acre.
3. Began and completed 479 mi. of irrigation canals, 115 mi. of drainage and waste-water ditches, 80 mi. of irrigation and drainage pipe line, 536 bridges and 1022 culverts; laid in dams and other irrigation works enough concrete to build more than 2000 mi. of city sidewalks 6 ft. wide and 3 in. deep; manufactured 500,000 barrels of sand cement; constructed 3 mi. of dikes, 27 mi. of railroads, 17 mi. of electric-transmission lines, 45 mi. of telephone lines, 36 mi. of wagon roads and 120 buildings.
4. Maintained and operated 7130 mi. of irrigation canals, which, if in one continuous canal, would reach in an air line from Palm Beach, Fla., to Fairbanks, Alaska, and back again; 548 mi. of drainage and waste-water ditches, 19 mi. of standard-gage railroad, 374 mi. of electric-transmission lines, 2180 mi. of telephone lines, 733 mi. of wagon roads.
5. Excavated 14,000,000 cu. yd. of earth and stone.
6. Protected 144,000 acres of irrigated lands against water logging by construction of drainage ditches and underground drains.
7. Brought 110,813 acres of additional lands under irrigation and made 60,000 acres more susceptible of irrigation.
8. Opened 4000 acres of land to homestead entry under the reclamation law.
9. Initiated co-operation between Reclamation Service and States of Oregon, California and Washington in construction work.
10. Inaugurated system of co-operation with Department of Agriculture to promote better farming on projects, for study of farm credits, and promotion of organizations for improving, grading, branding and marketing of farm products.
11. Initiated new policies of supervision under reorganization of service, by which heads of five divisions comprise a commission for management of service.
12. Co-operated with Governors of irrigation States in creation of Interstate Irrigation Commission.
13. Reduced ratio of general expenses from an average of 9 per cent during the preceding three years to less than 6 per cent during the calendar year 1914.
14. Introduced a policy of publicity, keeping the water users informed of how their money is being spent, and of co-operation with the water users in the determination of new policies affecting their projects.

GROSS OPERATING REVENUES FOR SEPTEMBER on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1182 per mile, showing a decrease of $75 or 6.0 per cent as compared with September, 1913. Operating expenses were $781, showing a decrease of $73, or 8.5 per cent. Net operating revenues, therefore, were $401—a decrease of $2 or 0.5 per cent. The operating ratio was 66.1 per cent, as compared with 67.9 per cent in September, 1913, and 64.3 per cent in September, 1912. Considering the three main districts, the respective ratios for September, 1914, and September, 1913, were as follows: Eastern district, 67.9 and 71.6; Southern, 74.7 and 71.5; Western, 61.4 and 62.8.

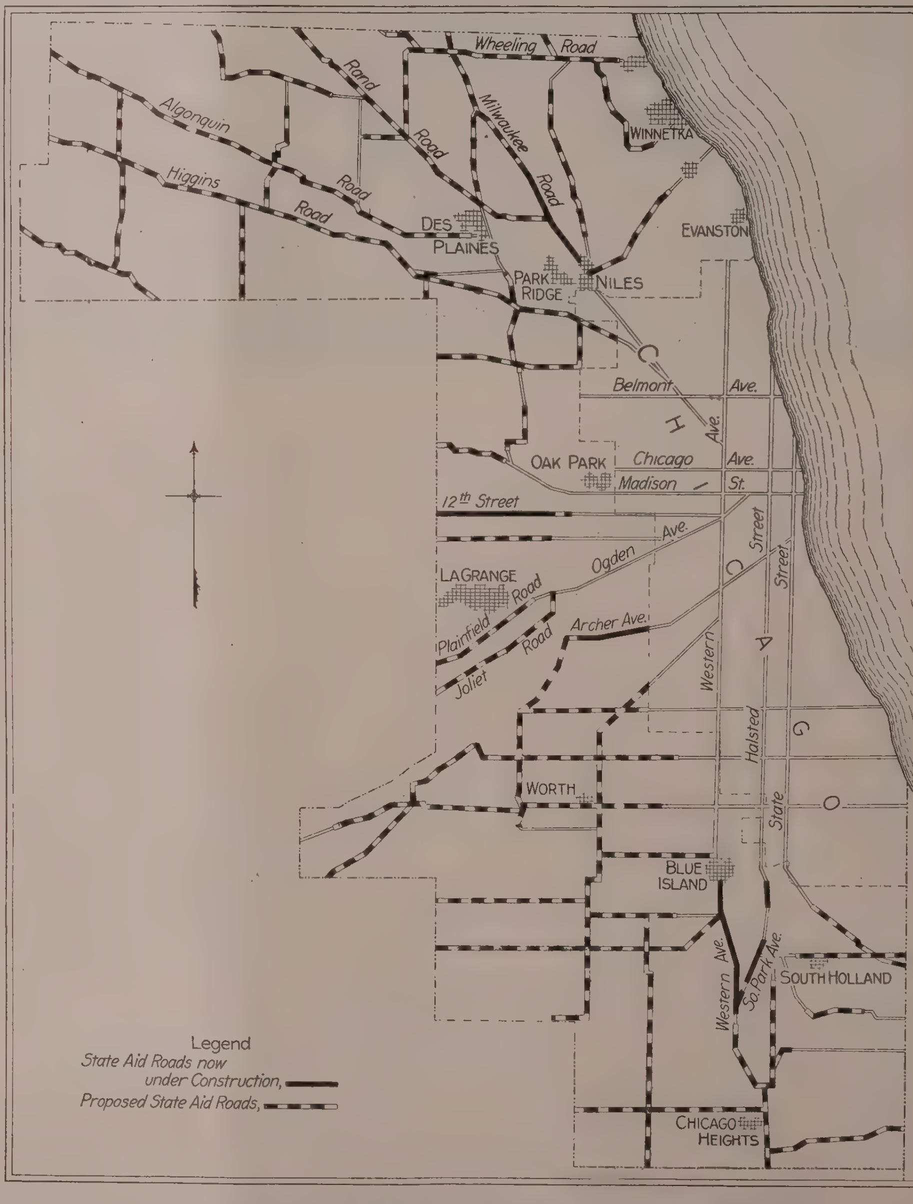
Highway Program of Cook County, Illinois

Description of the Organization and Equipment Used for Construction, Maintenance and Proposed Work

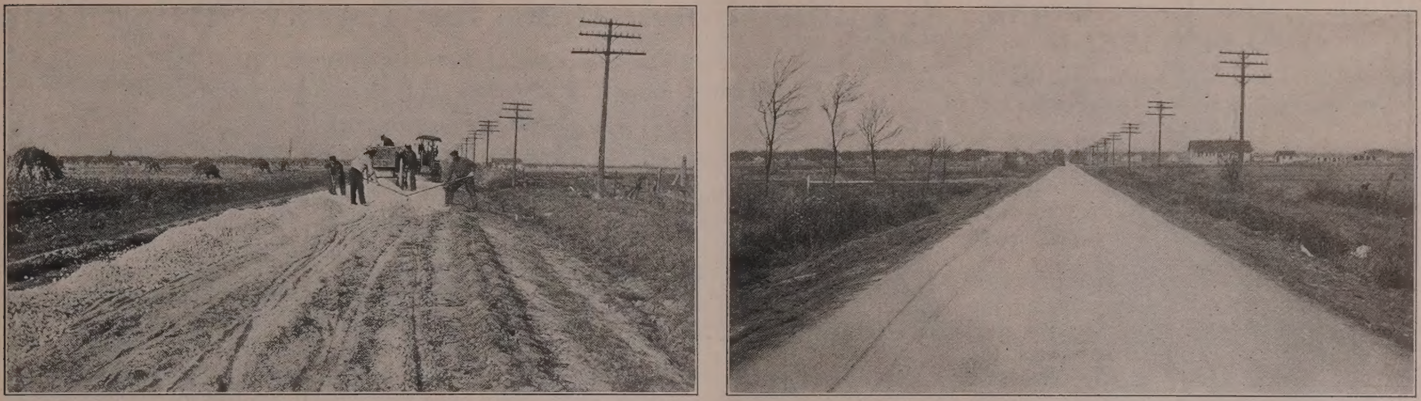
WHEN the citizens of Cook County, Ill., recently voted $2,000,000 for permanent county highways they possessed for the first time a fully organized and equipped county highway department which contrasted favorably with the system that existed prior to March 4, 1914, when the county highway work was entrusted to the officials of twenty-five townships.

ORGANIZATION

The new organization consists of a superintendent of highways, a senior and a junior engineer, a stenographer, a draftsman, eight inspectors, three men for operating road-rollers and three men for operating the graders and scarifiers used in connection with the road-roller outfits. The inspectors at the present time are examining the construction of bridges, making daily reports to the superintendent of highways, testing sand and gravel, and obtaining samples of cement and material used for the test. These inspectors are continually



COOK COUNTY STATE-AID ROADS UNDER CONSTRUCTION AND PROPOSED



LAYING CRUSHED STONE AFTER ROAD HAS BEEN SCARIFIED AND FINISHING SURFACE WITH ROLLER

on the job when concreting, excavation or form work is in progress.

The maintenance and repair equipment recently purchased by the county includes three sets of road machinery, comprising in each case a road roller, grader and scarifier, sprinkling cart and a plow. Men are also furnished by the county to operate the machinery. The three outfits work in co-operation with the various townships, and the townships designate what roads are to be repaired and furnish and haul all material. The county forces scarify the road, roll it, wet it and roll it again. Since September, 1914, the county and townships have removed the ruts and placed in fairly smooth condition 6 mi. of road in New Trier, Maine, Proviso, Riverside, Lyons, Northfield and Palatine townships. Contracts amounting to about $40,000 have been let for the repair of roads, exclusive of the work done by the road roller outfits.

CONSTRUCTION IN 1914

Contracts have been let and are approaching completion for approximately 14 mi. of concrete State-aid road work. The total contracts let amount to $148,095, exclusive of $65,783 for cement. The roads were built according to the State highway standards and are 18 ft. wide, 8 in. thick at the crown, which is 2 in., and have ¼-in. felt expansion joints spaced every 100 ft. Supervising the work on each contract of State-aid road the State has an inspecting engineer who reports directly to H. B. Bushnell, State division engineer. On Nov. 5 a contract was let for 1½ mi. of concrete road on Twelfth Street. Plans and specifications have been prepared for 2½ mi. of concrete pavement on Milwaukee Avenue to begin at the northern limits of the contract now under way and to extend to the Des Plaines River. It is expected that this contract will be awarded shortly. This additional 2½ mi. added to the work now under way on Milwaukee Avenue will make a continuous stretch of concrete beginning at the northern limits of the village of Niles and extending in a northwesterly direction 7 mi. When completed, this will be the longest straight stretch of concrete road in the State.

FUNDS AVAILABLE

The total amount of funds available for State-aid road work in the county for 1914 was $276,000. Of this amount $120,000 was allotted by the State and a similar amount by the county on March 4. An additional allottment due to the failure of other counties to avail themselves of the State funds, enabled Cook County to have re-allotted to it $18,000 and the county immediately appropriated a like amount. Approximately $16,000 has been spent on bridges and culverts.

Specifications for the utilization of the recently voted $2,000,000 are now being prepared. For the surveys and plans the Cook County Board of Commissioners has been requested to designate roads to be improved in 1915 out of bond issue. About 25 mi. of roads shown on the accompanying map will be improved. Contracts will be let and supervised by George Quinlan, county superintendent of highways, acting under the advice of the State Highway Department.

Favorable Tests of Elmira Brick

Performance of Blocks Made from Shale Mined at Reformatory Grounds Indicates Abundance of Good Material in New York State

CONSIDERABLE importance is attached by the officials of the New York State Highway Commission to the investigations recently made of the brick shale in the grounds of the State Reformatory at Elmira. The results were, in fact, so encouraging that the department is of the opinion that good brick-making shale may be found in the entire belt from Elmira to the Hudson River near Albany.

The tests were made in connection with the State's material survey and were under the charge of H. S. Mattimore, of the Bureau of Tests. In a large hill practically made up of shale nine pits were located. About 8 tons of the material were mined and sent to be made into brick in private experimental kilns. The shale worked up easily and was found to be sufficiently plastic for economical brick making without the addition of clay. It is quite unusual that it was not necessary to alter the first mixture.

DETAILS OF TESTS

Six hundred bricks were sent to the testing laboratory of the State Highway offices in Albany and tested to determine porosity, modulus of rupture and loss by abrasion. The small kilns had in many cases permitted too rapid cooling and non-uniform drying, so that some of the bricks were very coarse. These suffered a heavy loss in the rattler and were thrown out of consideration, other blocks more carefully made from the same material being secured. All bricks in fair condition passed the rattler test, which, as used by the New York department, specifies a maximum abrasion loss of 24 per cent. Some of the specimens lost as little as 21 per cent, and 22½ per cent may be taken as a fair average. One lot was made of material taken from an exposed face on the hillside. It was found that these ground very readily and gave uniform results in conforming to all the tests. The commercial practicability of such brick particularly is evident.

The difficulty of securing normal brick from the experimental kilns was shown in the great variation between the performances of coarse, poorly ground brick and those made with more care. One lot of inferior block lost 32.3 per cent in the rattler and were broken easily, the indicated modulus of rupture being 1585 lb. Yet bricks made of material from the same test pits with greater care lost only 21.6 per cent by abrasion and offered strong resistance to breaking, the modulus of rupture in one instance being 4077 lb. The normal blocks passed the absorption and breaking tests without difficulty.

MEANING OF INVESTIGATIONS

Some publicity has been given these investigations, but probably their meaning is not generally understood. Private companies have not opened pits to any extent in the vicinity of Elmira, and excessive freight charges make the use of brick from outside sources very expensive. The saving in freight charges by the State's venture would probably be as great an advantage as the reduction in cost of manufacture and the elimination of sales organizations. The section has been an especially difficult one for the improvement of highways. Most of the local stone is of such poor quality that its use is not practicable. Another advantageous factor is Elmira's central position in the district subject to these conditions.

The tests indicated that the shale was uniform. Very few sandstone layers were encountered, and with the exception of one or two strata 2 ft. in thickness, these were less than 3 in. thick. The depth of shale between the thin sandstone layers was from 12 to 36 in.

PLANS FOR BRICK PLANT

Plans are now being formulated to entrust the State Prison Department with the establishment of a plant equipped to turn out about 40,000 bricks per day, and it is hoped that speedy action will be taken. The finished material will be tested in the laboratory of the State Highway Department, just as all materials are at present. If the expected success is met very probably the organization will be enlarged and additional plants built. Studies will later be made of the shale in other sections of the State remote from brick plants.

Work of the U. S. Geological Survey, 1913-14

Statistics as to Areas Surveyed Geologically and Topographically and as to Classification of Public Lands

THE work accomplished by the U. S. Geological Survey during the fiscal year ended June 30, 1914, described in the report of the Secretary of the Interior issued recently, has been:

1. Completion of detailed geological surveys covering 12,000 sq. mi., including 180 sq. mi. in Alaska, and reconnoissance geological surveys of 57,000 sq. mi. in the United States and 6500 sq. mi. in Alaska, the total territory surveyed geologically during the year being as great as the combined area of Denmark, Switzerland and Greece.

2. Making of topographic surveys covering 23,000 sq. mi. in the United States, 6000 sq. mi. in Alaska and 342 sq. mi. in Hawaii, or an area more than the Netherlands and Belgium combined.

3. Continuation of stream gaging at 1400 stations in thirty-nine States and in Alaska and Hawaii.

4. Classification of 47,000,000 acres of public lands, an area larger than the New England States, including the following items:

a. Designation as non-irrigable and open to entry under the enlarged homestead act of 33,000,000 acres in twelve States, or enough land to make 100,000 homesteads of 320 acres each.

b. Examination and classification of 2,400,000 acres of Indian lands and 1,700,000 acres of withdrawn phosphate lands.

c. Restoration to entry of nearly 9,000,000 acres of land of all kinds previously withdrawn for classification, including 8,275,000 acres of coal-land withdrawals, of which 1,300,000 acres were appraised and made available for purchase as coal lands, 188,000 acres determined not to contain oil, 260,000 acres classified as non-phosphate and 90,000 acres decided not to be essential to water-power development.

d. Causing of the withdrawal of a total of 752,500 acres, including 209,000 acres of oil lands, 170,000 acres of phosphate lands, 92,000 acres as possibly containing potash, 183,000 acres reserved for water-power sites and 75,000 acres of public water reserves.

5. Making annual census of mineral production through correspondence with about 90,000 mineral producers.

Grouting Foundations for Gravity-Section Dam

Holes 40 Feet Deep and 10 Feet Apart Were Drilled and Grouted in Soft Shale Overlying Sandstone Quartzite

By HAROLD S. JOHNSTON
Resident Engineer, Calgary, Alberta

GROUTING of the foundation of an overflow dam was done in connection with the construction of the Horseshoe Falls plant of the Calgary Power Company on the Bow River in Alberta. The design of this plant was described in the Engineering Record of Feb. 7, 1914, page 152. In building the dam the construction of the final 226 ft. had to be suspended until October, 1910, because of the failure of the cofferdam for the dam site on May 7, 1910, due to an extraordinary rise in the river for that time of the year. The unwatering tunnels could carry a maximum of 3500 sec.-ft. The flood, however, rose beyond this mark to 7000 sec.-ft., overtopped the cofferdam, undermined it at the center and finally swung the westerly portion attached to the bank away from its seat. The excavation was flooded for the final section of the dam, in which a small quantity of concrete had been placed. There was no possibility of reconstructing the cofferdam until the flow of the river could again be taken care of by the unwatering tunnels, which was in the middle of September. In October the work on the dam was resumed.

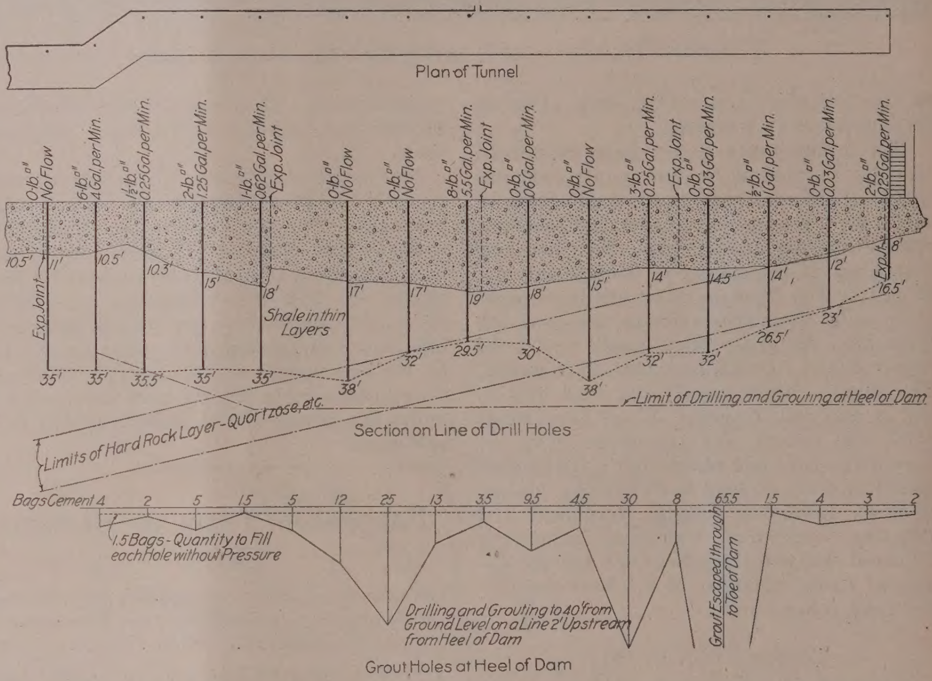
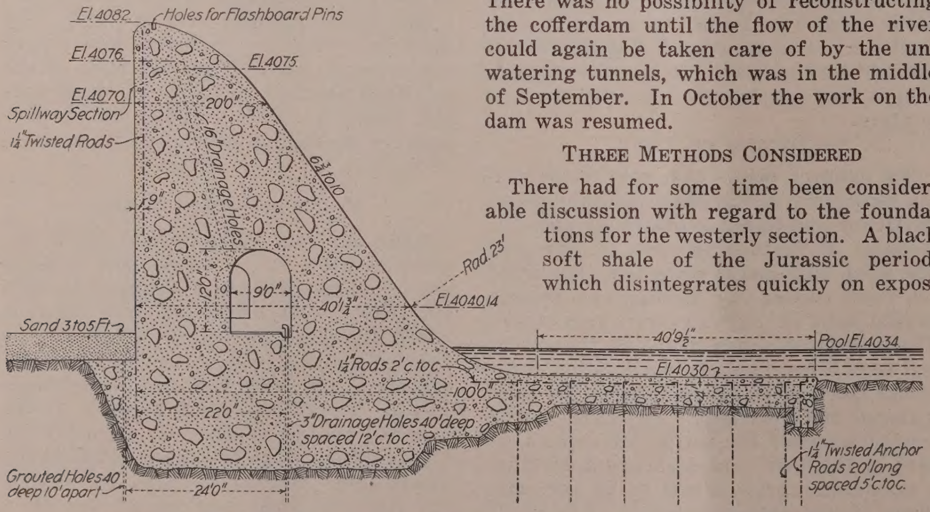

Plan of Tunnel
0-lb. ⌀" No Flow
6-lb. ⌀" 4 Gal. per Min.
½-lb. ⌀" 0.25 Gal. per Min.
2-lb. ⌀" 1.25 Gal. per Min.
1-lb. ⌀" 0.62 Gal. per Min.
Exp. Joint
0-lb. ⌀" No Flow
0-lb. ⌀" No Flow
8-lb. ⌀" 5.5 Gal. per Min.
Exp. Joint
0-lb. ⌀" 0.6 Gal. per Min.
0-lb. ⌀" No Flow
3-lb. ⌀" 0.25 Gal. per Min.
Exp. Joint
0-lb. ⌀" 0.03 Gal. per Min.
½-lb. ⌀" 1 Gal. per Min.
0-lb. ⌀" 0.03 Gal. per Min.
2-lb. ⌀" 0.25 Gal. per Min.
10.5'
11'
10.5'
10.3'
15'
18'
17'
17'
19'
18'
15'
14'
14.5'
14'
12'
8'
16.5'
Exp. Joint
Exp. Jt.
Shale in thin Layers
35'
35'
35.5'
35'
35'
38'
32'
29.5'
30'
38'
32'
32'
26.5'
23'
Limit of Drilling and Grouting at Heel of Dam
Limits of Hard Rock Layer-Quartzose, etc.
Section on Line of Drill Holes
Bags Cement 4 2 5 1.5 5 12 25 13 3.5 9.5 4.5 30 8 65.5 1.5 4 3 2
1.5 Bags - Quantity to Fill each Hole without Pressure
Drilling and Grouting to 40' from Ground Level on a Line 2' Upstream from Heel of Dam
Grout Escaped through to Toe of Dam
Grout Holes at Heel of Dam

DIAGRAM INDICATING FLOW AT WEEPERS AND AMOUNT OF GROUT INJECTED



CROSS-SECTION OF DAM AND LOCATION OF GROUTED HOLES AND WEEPERS

THREE METHODS CONSIDERED

There had for some time been considerable discussion with regard to the foundations for the westerly section. A black soft shale of the Jurassic period, which disintegrates quickly on exposure to the weather, lay upon the 6 ft. layer of sandstone quartzite to depths varying from nothing to 50 ft. over the westerly foundation. Three methods of construction were proposed: (1) to excavate all the shale underneath the dam to the sandstone layer, (2) to put down a narrow heel trench to the sandstone layer and leave the balance of the shale under the dam, and (3) to excavate only enough shale under the dam to form a satisfactory seat below the disintegrated surface with small toe and heel trenches, and drill and grout numerous holes over the foundation to solidify and fill up the seams in the shale. The objection to all these plans are apparent.

In September John R. Freeman was finally called into consultation by the Calgary Power Company and the final section was built in accordance with his design. He considered the shale suitable after the disintegrated surface had been removed, believing that its stability was unquestionable and that its bearing strength and rigidity were more than ample to support the weight of the dam. He advocated making sure, however, that no open seams or bed joints remained between the soft strata of rock through which water could penetrate, and recommended drilling and grouting to guard against this feature.

GROUTED HOLES TO FILL SEAMS

Part of his plan called for the drilling of holes 40 ft. deep and 10 ft. apart, at a distance of 2 ft. from the heel of the dam. These were to be cleaned out with water under pressure, and grouted to fill the seams of the shale. This work was done by the company's own forces with A. M. Torpen as superintendent. The operations did not interfere with the placing of concrete, which was an important factor, considering the time already lost.

A heavy marine drill was used, slung from a frame supported by the trestle used for depositing concrete. The drilling was prosecuted with double shifts. After a hole was drilled it was cased and then washed out with water under pressure. The grout used consisted of cement and water only mixed to a consistency that would pour easily. It was kept mixed in a half barrel from which it was taken by a duplex pump and discharged into the hole. This was neither the most efficient nor the most economical arrangement, but reached the end planned with the least amount of time lost waiting for equipment. The pressure under which the grout was forced varied between 90 and 100 lb., as shown by a gage just above the casing. The greatest amount of cement used in any one hole was sixty-five and a half bags, but at this hole an outlet existed completely underneath the dam, so that the grout was found to be coming to the surface of the rock a short distance beyond the toe of the dam.

INTERCEPTING LEAKAGE

Mr. Freeman's design also called for an inspection tunnel through the last 226 ft. of the dam, from which holes were to be carried through the foundation concrete down into the rock a certain distance to intercept any leakage not cut off by the grouting operations at the heel of the dam, and which might cause uplift pressure. The holes give evidence of any injurious amount of underflow and the tunnel gives an opportunity for grouting the foundation wherever such leakage is becoming abnormal. This latter work was performed under the superintendency of the writer, and the results obtained from the two schemes are shown on the diagram herewith. From the amount of water escaping and the pressure under which it was escaping at some of the holes drilled inside the tunnel the wisdom of this scheme was demonstrated. The results shown on the diagram were obtained immediately after the drilling had been completed, but it is curious to note that the pressure and rate of flow vary from time to time. A Davis Calyx core drill was used for the work inside the tunnel, which was performed after the pond was filled and the plant was in operation.

Mr. Freeman also advocated the use of 2 x 2 ft. drainage openings running from the upstream springing line of the tunnel arch on an angle of 15 deg. to the vertical to within 5 ft. of the surface of the concrete at the top of the dam. These were spaced on 16-ft. centers, and all have carried off seepage water. This system, as Mr. Freeman pointed out, is of special value where the winter climate is as cold as in Alberta, as any seepage is intercepted before it can reach the exposed face of the dam and become frozen so as to exert a disintegrating action. Time has proved that it would have been better to place these drains on 10-ft. centers, as in some cases seepage has shown on the downstream side of the tunnel just midway of the 16 ft. between drains. The walls of the tunnel, however, are evidence of the efficacy of the drainage scheme.

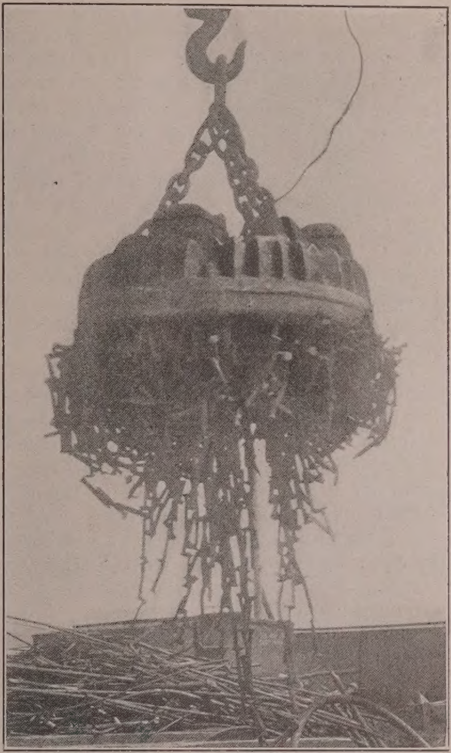
In addition to the above precautions, a drift 50 ft. long was driven from the tunnel in the dam into the rock at the west abutment, which was mostly shale. The purpose of this drift was to cut off any leakage around the end. This leakage did show up after the pond had been filled. The drift was then driven and is doing its work exceedingly well. Two hundred gallons of water per minute are discharged from the tunnel, most of which comes from the drift. The signs of leakage around the end also disappeared to a great extent after the drift was finished.

Scrap-Handling Plant of Boston & Albany Railroad

West Springfield Layout Includes Machinery for Breaking Up and Sorting Junk and Gantry Crane Equipment with Lifting Magnet

AN instance of the greater attention now being paid by the railroads to the reclaiming of discarded material, thus obtaining greater revenue through the recovery of usable parts and the sale of junk unfit for further use, is afforded in the new scrap-handling plant of the Boston & Albany Railroad at West Springfield, Mass.

The plant consists of a storehouse 25 x 40 ft. with a connecting shed 25 x 50 ft. housing the motor-driven tools. A high platform 10 ft. wide on the sides and 30 ft. wide on the end extends around three sides of the building. Beyond the end of this platform and level with the ground extends a low platform 45 ft. wide (the combined width of building and high platform) and 200 ft. long, on which the scrap is sorted. This lower platform is constructed of cinders and screenings, and is composed of fifteen bins 10 ft. wide, with a large bin 50 ft. wide in the center. On each side a track for loading and unloading extends the entire length of the platform, and a 5-ton gantry crane, running on rails laid on a continuous concrete foundation 80 ft. on centers for a distance of 400 ft., spans the entire layout. The gantry is equipped with a magnet of 3500 lb. capacity.


MAGNET WITH LOAD OF SPIKES

GANTRY CRANE AND SORTING PLATFORMS AT SCRAP-HANDLING PLANT

In the shed the tools consist of a pair of alligator shears, driven by a 7½-hp motor; a drop hammer, driven by a similar motor; a bolt threader and nut tapper and a magnetic chip separator. The latter two pieces of machinery are driven from a line shafting operated by a 7½-hp motor.

The crane is a standard three-motor 5-ton gantry. The span of wheels, as previously stated, is 80 ft. and the maximum travel of the hook from lower to upper limits is 22 ft. The clearance from under side of girders to base of rail is also 22 ft. The wheel loading, with maximum lift, is 28,000 lb. The main hoist is driven by a 22-hp motor and lifts at a speed of 40 ft. per minute. The trolley running on the bridge is driven by a 3-hp motor and travels at the rate of 125 ft. per minute. The bridge is operated on the rails by a 22-hp motor and travels 200 ft. per minute. All motors are two-phase 60-cycle, 440-volt, of the General Electric type. They are inclosed on four sides and the top by galvanized corrugated iron with necessary doors for inspection.

CRANE DETAILS

The crane bridge girders are of box section, built up of two web plates, four heavy angles and universal mill top and bottom cover plates. At frequent intervals the web plates are reinforced by heavy vertical angles connected together by diaphragms to prevent vibration and diagonal skewing when the crane is started suddenly. The bridge motor is bolted in a horizontal position to a heavy structural steel bracket riveted to the girders. The motor gears are inclosed and run in self-oiling bearings. The cross shaft is of extra heavy steel and is sufficiently strong to skid the truck wheels with the crane fully loaded, thereby preventing distortion in the shaft due to careless handling. At uniform intervals the shaft is supported by adjustable split, babbitted bearings, which can be removed without disturbing any other part.

The bridge ends are built up of plates and angles. Heavy gusset plates connect the girders and bridge ends and prevent the girders from getting out of square. All connection holes were drilled and reamed after the parts were assembled and squared, and only finished body round bolts with lock nuts were used for connecting these parts.

Extra heavy truck wheels with double flanges have been provided, the treads being accurately machined or ground to equal diameters. The trucks are bronze bushed and revolve on turned steel axles of large diameter fitted in bored holes in the reinforced bridge ends and securely held by heavy plates. Bronze washers are provided between ends of truck wheels and web plates. The truck wheels may be easily removed by jacking up the bridge ends sufficiently to remove the weight from the wheels.

APPURTENANCES

The cross shaft is connected to the vertical shaft and the vertical shaft to the bridge truck wheels through the medium of cut bevel gears. The vertical shafts are carried in universal thrust bearings, making it impossible for the shafting and gears to get out of line.

The hook frame and yoke are of steel, having a factor of safety of six on all parts, which are accessible for oiling and examination. The extra heavy bronze-bushed rope sheaves are turned and grooved to fit the rope, and revolve on turned steel pins held in position by key plates that are easily removed to permit withdrawing the pin, which is drilled for center oiling. The hook revolves on hardened and grooved steel balls running between hardened and grooved steel plates.

The lifting magnet is of 3500 lb. capacity and has a lifting surface 3 ft. in diameter. When not in use it is set on the platform. Direct current for the magnet is supplied by a 7½-kw, 230-volt General Electric motor generator set bolted on the side of the bridge girders of the crane and controlled by the operator from the cage. The current consumed when lifting 3500 lb. is about 45 amp at 230 volts.

Current for all purposes, including lighting, is generated in the railroad company's power plant located about a quarter of a mile away.

OPERATING RESULTS

Although the plan has only been in operation since Jan. 1, a saving of 10 cents per ton in the handling of scrap has been effected. Prior to the construction of the plant scrap was sorted and broken by hand labor at West Springfield and at other points along the line. Under the present arrangement the junk is forwarded to the scrap platform from all points and is there broken and sorted into bins awaiting sale or reclamation for further use, as the case may be.

Under the old method, for a period of eight months, 9748 tons of scrap were handled, compared with 19,196 tons for a similar period under the new method. A saving in favor of the new method of 21.6 per cent in the cost per ton of scrap handled was shown. Comparing the use of the new gantry crane alone with the old method of handling by manual labor and hand crane for a period similar to that above mentioned, a saving of 63.3 per cent in the cost per ton of scrap handled has been effected. In addition, the net value of material reclaimed from scrap and made fit for use, during the above period of time, amounted to more than $1000 in excess of the total cost of labor for running the entire plant, while under the old method practically nothing was reclaimed.

The reclaimed material includes brake shoes, brake pins, brake levers, connection rods, couplers, follower nuts, washers, firehooks, bolts, spikes, side irons, tieplates, shovels and round and flat irons.

The installation was made from plans prepared by the engineering department of the Boston & Albany Railroad.

A Gravel Dredge Which Delivers Graded Materials

Outfit Comprises Two Sets of Screens, Crusher, Elevator, Bins and Chutes Besides Accommodations for Twenty-Four Men

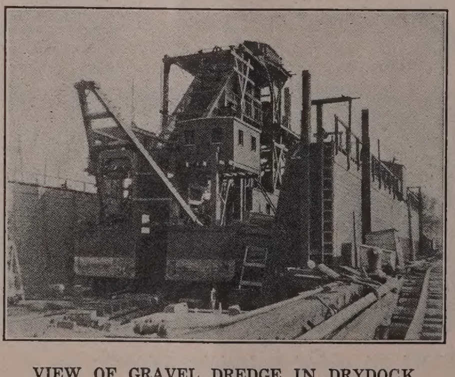
By ALBERT GOTTSCHALK
St. George, Staten Island, New York

A GRAVEL dredge, delivering graded materials, has recently been designed for the Eastern Gravel Corporation, of New York City, and put into operation in Long Island Sound. The dredge is of the continuous bucket type, and is arranged for the delivery of three grades of material into three barges. The sorting is done by twin revolving screens, and a crusher has been provided to take in pebbles as large as 8 in., thus avoiding a separate crushing plant and saving the cost of handling.

The accompanying picture represents the dredge in dry-dock before its completion; it shows the runway for the bucket chain. On the left is the pilot house, from which the greater part of the machinery is governed; on the right, living quarters for the captain.

Provision has been made for different combinations of the sizes of material produced by the screens. The chute frames are hinged on the edge of the hull, so that, after lifting up the chutes, the whole system may be pulled in.

The buckets take the material to the top of the dredge and dump it upon a screen, which rejects all pieces above 8 in. in size. A pair of revolving twin screens takes care of the sizing of the material passing the first screen and of the distribution through hoppers into the chutes. Oversizes from the screens, which may, by a flop-door arrangement, include the material from the last perforated screen section, falls into the crusher, which is located right under the screens, and is redelivered into the latter by an elevator. A derrick has been placed on top of the dredge, to facilitate the handling of the screen plates.



VIEW OF GRAVEL DREDGE IN DRYDOCK

The house in the rear part contains kitchen, dining room and sleeping quarters for twenty-four men. This furnishes an opportunity of running the plant in two shifts, without the need of a separate house boat.

Cost of Floors for Buildings

Granolithic Floors, When Laid with Troweled Surface, Are the Cheapest, While Cork Tile Is the Most Expensive

PRICES of floorings for buildings based on estimates of cost in place are given in a paper entitled "Floor Surfaces in Fireproof Buildings" delivered by Prof. Sanford E. Thompson Dec. 2 at the thirty-fifth annual meeting of the American Society of Mechanical Engineers. For the materials like hardwood that are laid after the partitions are placed, the prices apply more particularly to a building such as a college or other institution divided into offices and rooms of various sizes. Each price is assumed to include total cost of labor and material, exclusive of the structure itself. It is assumed that the base upon which the floor is laid is either structural concrete or some similar material.

UNIT COSTS OF FLOORINGS

	Cost per sq. ft.
Granolithic	
Laid at same time as base; troweled surface	$0.05
Laid at same time as base; ground surface	0.08
Laid after completion of base; troweled	0.07
Laid after completion of base; ground	0.10
Linoleum	
Battleship linoleum, including $0.03 per square foot for placing and troweling a ¾-in. layer of mortar immediately after base concrete is laid, linoleum being figured at $1.30 per square yard, cemented in place	0.18
*Hardwood**	
Maple or birch, single thickness, including $0.01 for leveling off base concrete and including stringers with cinders between, with rough 1-in. floor underneath	0.22
Maple or birch, single thickness, including $0.01 for leveling off base concrete and including stringers with cinders between	0.18
Maple or birch, single thickness, including $0.01 for leveling off base concrete and including stringers with cinders between, with rough 2-in. floor underneath	0.25
Terrazzo	
With small stone ⅛ to ½ in., including $0.01 for leveling the base concrete†	0.19
With large stone ⅜ to 1 in., including $0.01 for leveling the base concrete†	0.24
Base 6 in. high, per lin. ft.	0.36–0.50
Marble Mosaic	
Grouted and ground	0.50–0.60
Magnesium Composition	
For large areas, say 100,000 sq. ft., including $0.01 for leveling base concrete	0.20
For small areas, say 25,000 sq. ft., including $0.01 for leveling base concrete	0.24
Asphalt Flooring	
Including $0.01 for leveling base concrete	0.15–0.17
Asphalt Mastic	
For areas 100,000 sq. ft. or more including $0.01 for leveling base concrete	0.15–0.16
In chemical laboratories	0.17–0.18
6-in. sanitary base, per lin. ft.	0.25
Tile	
Quarry tile	0.35–0.40
Fancy pattern tile	0.50
Cork Tile	
Moravian tile, fancy pattern	0.75–1.25

*These prices are based on good quality of hardwood at about $45 per 1000 ft. b.m.

†For areas of 50,000 sq. ft. or more, deduct 10 per cent from these figures.

THE CABLEWAYS for the Cleveland filter construction plant described in the Engineering Record of Nov. 7, page 504, were equipped with American Steel & Wire Company wire ropes instead of Roebling ropes as erroneously stated in the article.